Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

September, 1931

Volume 105 *No. 9*

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Published on the first Thursday of every month by the

Simmons-Boardman Publishing Company

34 North Crystal Street, East Stroudsburg, Pa. Editorial and Executive Offices,
30 Church Street, New York

Chicago: 105 West Adams St.
Washington: 17th and H Streets, N. W
Cleveland: Terminal Tower
San Francisco: 215 Market St

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Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the biennial convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, and Mexico, $3.00 a year; Canada, $3.50 a year, including duty; foreign countries, not including daily editions of the Railway Age, $4.00.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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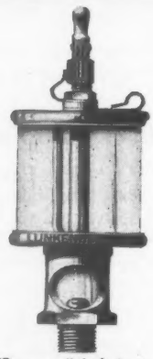
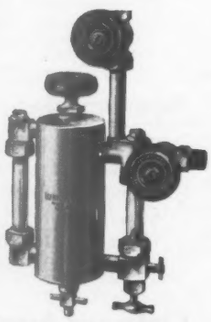


"Paragon" Lubricator

"Sentinel" Oil Cup



"Senior" Lubricator

"Alsen" Oil Cup
Aluminum Body

"Penlo" Lubricator

Bronze Plain Oil Cup

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Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

September - 1931

Electric Line Installs High-Speed Aluminum Cars

Aluminum alloys used in the construction of the frames and body, except the bumpers—Also extensively used in the construction of the air brake and other equipment—Saving of 40,000 lb. in the light weight of each car

ELECTRIC railways, as well as steam roads, are giving increased consideration to light-weight equipment and high operating speeds, as indicated by the recent purchase of 35 multiple-unit cars equipped with high-speed motors and all-aluminum bodies by the Indiana Railroad System, an electric line which operates more than 5,000 miles of track, largely in Indiana. These cars, 21 of which were built by the Pullman Car & Manufacturing Corporation and 14 by the American Car & Foundry Company, are capable of speeds in excess of 70 m.p.h. and are expected to reduce the running time for the 123 miles between Fort Wayne, Ind., and Indianapolis, for example, to slightly over three hours. An equivalent running time will also be maintained for the 117 miles between Indianapolis and Louisville, Ky.

Rear view showing rounded end and roof construction, also Tomlinson car, air and electric coupler

Designed for interurban service, the new cars can be operated in multiple-unit trains, car connections being made by means of the Tomlinson No. 10, car, air and electric couplers, having manually-controlled, air-operated uncoupling mechanism. When run as single units, the cars are arranged for one-man operation. They have flush floors from end to end, the entrance and exit doors being at the front-end vestibules on the right side. The main passenger compartment carries 20 bucket-type fixed seats, each designed to accommodate two persons. The rear platform is arranged for baggage space with an emergency door on the right side. A toilet room with flushing hopper, wash basin and water-cooler is provided.

Fourteen of the cars are equipped with observation-lounge compartments, taking up the rear third of each car and having a seating capacity of 10, with 28 seats available in the coach compartment. The interior arrangement and equipment of all the cars afford maximum convenience and comfort. The coach chairs are upholstered with genuine leather, head and arm rests being provided for complete relaxation. Wide windows afford maximum visibility and produce ample light necessary for a bright and cheerful interior. Circulation of air is provided by means of ceiling ventilators, supplemented by two bracket fans on the front bulkhead.

During the winter months, the cars will be heated by automatic electric heating equipment, designed to maintain comfortable temperatures under all weather condi-

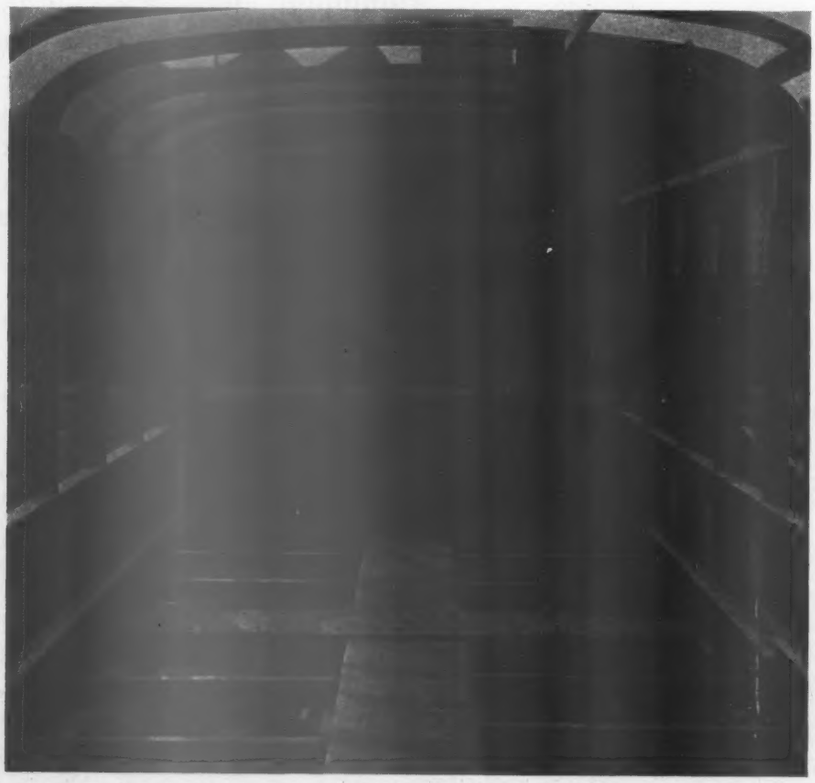
tions. Electric illumination is provided in the cars by means of a double row of ceiling lights of high intensity which will permit reading without eye strain. The lighting system is designed to provide a steady interior light whenever needed, independent of the trolley voltage. The compartments, decorated in two-tone shading on walls and ceilings, are furnished with thick carpeting, deep, upholstered chairs, solid American walnut tables, reading lamps and a pair of tapestry davenports. These compartments are available to all passengers without extra charge.

As shown in the table, each of the new cars is 46 ft. long between bumpers and has a light weight complete of 50,000 lb., being driven by four General Electric, 100-hp., 600-volt motors mounted on Commonwealth cast-steel trucks of the drop-equalizer type, equipped with Pullmanite journal boxes and American Steel Foundries Simplex multiple-unit clasp brakes. The car design provides an extremely low center of gravity which minimizes side sway as the car travels and makes it readily responsive to the controls. Wind resistance is reduced by the stream lines and rounded contours of the body construction.

Operation of the cars at high speeds of which the motors are capable is made safe through the use of strictly modern control and braking devices. Westinghouse standard HL non-automatic control, as well as the Westinghouse single-end safety car control equipment, with back-up feature, is provided, the cars being normally stopped by application of the clasp brakes mentioned. In addition, each car has a system of electromagnetic brakes which creates a magnetic field holding four special brake shoes against the rails and thus further increasing the braking power in emergency. Another safety feature in the control equipment is the provision for automatically shutting off the power and applying the brakes, if, for any reason, the motorman's hand releases the control.

Doubtless, the most important single feature of interest about the new Indiana multiple-unit car, from the point of view of steam railroad officers, is the extensive use of aluminum alloys in the car construction, and the methods of fabricating and handling this relatively new material. Practically the only steel used in the car body is the bumpers which are made of this material to meet the requirements of the state law. Many of the specialties, such as the Westinghouse air compressor, also are designed largely with aluminum parts so that aluminum is said to be used to a greater extent in this car than has ever been done before. In general, strong aluminum alloys are used for stress members and softer aluminum for the finished sheets. Since the completion of the car, it has been loaded in excess of the maximum body service load and stresses and deflections of the various parts of the car structures measured under these conditions. The stresses are said to be uniformly low, the deflections being kept strictly within good practice. The action of the car body under loading conditions is uniform, tests indicating that the stresses are well within the desired requirements and that there is a large factor of safety for all parts under operating conditions.

The light weight is 40,000 lb. less than that of older equipment replaced and, while all of this reduction cannot be credited to the aluminum alloys, the use of this material is responsible for a large proportion of it. The aluminum plates and shapes were handled in the shop without difficulty by car men accustomed to working with steel. No special precautions were necessary, except against overheating on the infrequent occasions when the aluminum shapes could not be formed cold. Welding operations, conducted by the experienced operators using the electric-arc process, were carried on much as in the case of steel construction. Weighing approximately one-third as much as equivalent steel shapes, the greatest difference noted in con-



Interior view showing the underframe and superstructure frame details

structing the car bodies of aluminum was the notably greater ease of handling sheets and fabricating parts in the shop.

The center sill of the multiple-unit car is a strong-aluminum pressing ¼ in. thick, extending from bumper to bumper. As shown in one of the illustrations, it is an inverted U-shape, being 20 in. wide by 6½ in. deep and with 2⅝-in flanges. This U-shape was pressed cold in a hydraulic press equipped with suitable progress dies to form the desired shape gradually as the sheet was advance through the press. In accordance with recommended practice, the radius bends in the U-shape were made approximately four times the thickness of the material. Separators are applied in the center sill at the bolster and cross bearers and, where needed, at floor pans, all holes being punched in the center-sill sheet before it was formed in a U-shape.

The side sills are rolled, strong-aluminum angles, 4 in. by 3 in. by ¼-in., cut to the required length, and with all holes punched before assembly. The body bolsters and cross-bearers are built up of diaphragms pressed cold in a hydraulic press and provided with top and bottom cover plates, all of aluminum. Holes are punched in the diaphragms after pressing, largely to assure accurate location. The cover plates are sheared and pressed to the desired form and holes punched ready for assembly. The cross ties, or floor supports,

General Dimensions of the Indiana Railroad All-Aluminum Multiple-Unit Car

Length over bumpers	46 ft. 0 in.
Truck centers	23 ft. 2 in.
Truck wheel base	6 ft. 6 in.
Width overall	8 ft. 10⅛ in.
Height, rail to floor	3 ft. 5⅛ in.
Height, rail to top of roof	11 ft. 1¼ in.
Seating capacity	40
Wheels, diameter	28 in.
Estimated light weight, complete car	50,000 lb.

are Z-shape, all being made of pressed aluminum. The body and platform end sills are also aluminum pressings of Z-shape with aluminum cover plates on the top and bottom extending to the bumpers. All underframe parts, after fabrication, were assembled by bolting together, holes reamed and hot steel rivets applied in the usual manner when building steel equipment.

Side and end posts of the multiple-unit cars are box-section aluminum pressings, the window sills also being aluminum pressings. The 2½-in. by ¼-in. belt rails are aluminum bars, end belt rails being of the same section but formed to suit the radius of the end of the car. Girder sheets about 2 ft. 10. in. deep on both the sides and ends are of aluminum. Extensions of the girder sheets are provided in the form of a skirt

Interior view after application of the wooden floor and roof

8 in. below the side sills. The letter board and side plate are in one piece, the sheet being pressed to form the window lintel and the side plate. A pressed-aluminum carline is located at each side post to which a wood carline for fastening the roof boards is bolted. Intermediate wood carlines are provided for ventilator and lamp post supports. The roof is wood with canvas in one piece stretched across it as is usual with cars having trolley-pole current collectors. The floor also is wood laid diagonally in two layers with waterproof paper between and ⅛-in. linoleum on top, except in the baggage space where the top floor is of maple and in the toilet room where ½-in. masticoke is laid on the lower floor.

The inside finish and headlining are of aluminum, the sheets being formed to the desired shapes and reinforcements spot welded to them for the application of brackets, etc. The toilet and partitions are of aluminum sheets. A water tank is located under the roof in the toilet. This tank, oval in shape, is made of aluminum

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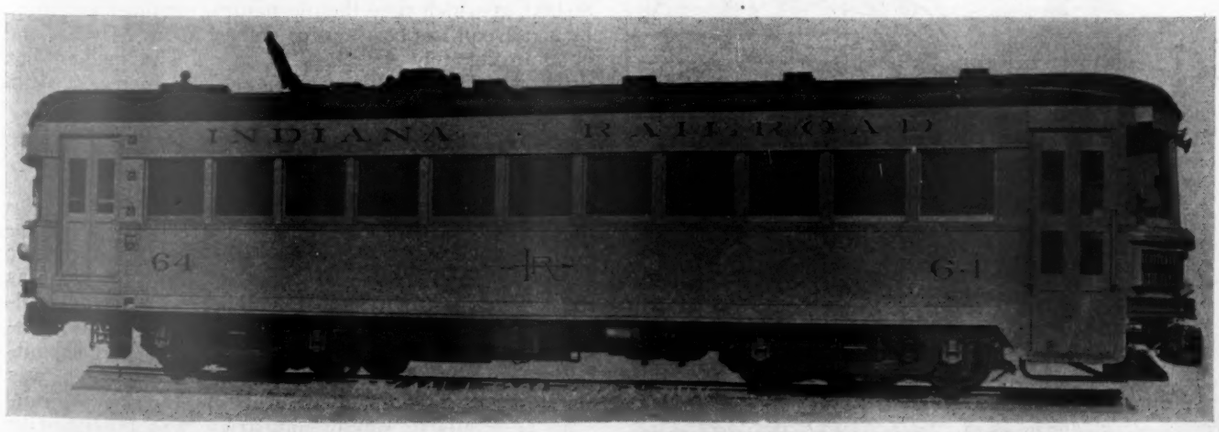


Multiple-unit car body embodying practically all-aluminum body construction

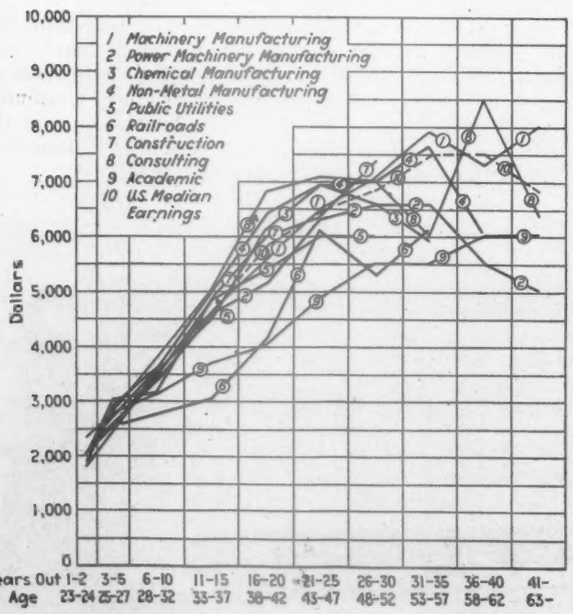
A. S. M. E. Reports That the Railroads Pay Low Salaries

Report by Committee on the Economic Status of the Engineer shows the median earnings of mechanical engineers in railroad service to be lower than the median earnings of mechanical engineers in any other industry —Earnings compare only with the teaching profession

THE Committee on the Economic Status of the Engineer, American Society of Mechanical Engineers, has reported that the median earnings of mechanical engineers in railroad service are lower than the median earnings of mechanical engineers in any other industry in the United States. As shown in one of the charts, railroad earnings compare only with the median earnings of mechanical engineers engaged in teaching.

The survey and preparation of the report were directed by Professor Elliott Dunlap Smith of Yale University, and the statistical computation was directed by Professor Hudson B. Hastings, also of Yale University. The figures are based on 1930 earnings. At that time, the effects of the present depression had not seriously reached professional salaries, and only a few salary cuts had been made. Furthermore, the figures shown in the report do not refer to average, but to "median" earnings. To get the median earnings in any classification, the salaries of all the engineers in the classification are arranged in a column in order of amount. The total number of entries in the classification is then counted, and the salary figure in the middle of all the figures in the column is then taken as the median of the classification.

According to the report, the committee believes that median earnings give a truer picture than the average earnings, because the exceptional salaries of the few men at the top inflate the mathematical average far above the earnings of the typical man; while the median, which is determined by position in the earning scale, not by averaging of salaries, is uninfluenced by exceptional top salaries. Average earnings are usually much more than median earnings. For example, the report states that the average of 1930 professional earnings of mechanical engineers between the ages of 53 and 58 (the age of maximum earning power) was $10,200, which is more than 36 per cent greater than the median earnings at those ages, which was $7,600.



Comparison of 1930 median earnings of mechanical engineers by type of industry

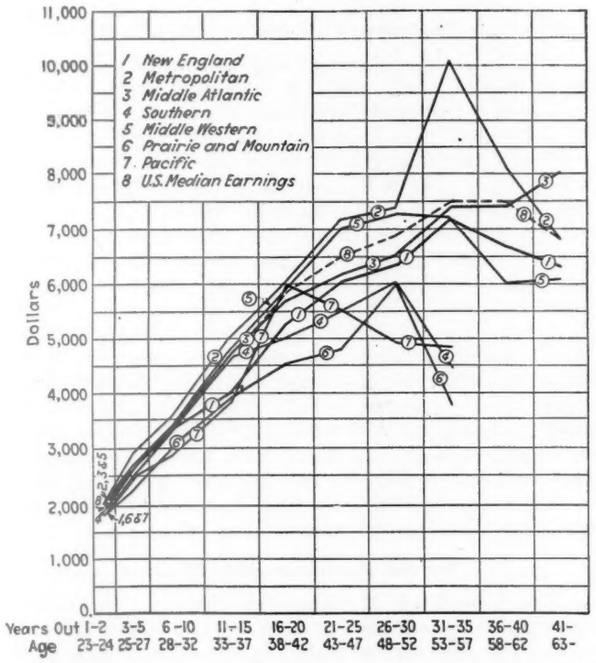
It is believed, the report states, that these figures are the most reliable that have been obtained as to engineering earnings. They are based on replies from over half of the membership of the American Society of Mechanical Engineers in the United States, which is approximately 18,000 members. A table in the report shows the distribution of engineers replying to the questionnaire by type of industry. Two per cent, or 127, of the questionnaires were returned by mechanical engineers employed in the railroad industry. The report states that, "although the number of returns from railroads is small, the results at all wage boundaries are so consistent as apparently to justify the inference that railroads pay below the median wage almost from the start."

Referring to the chart showing a comparison of the 1930 median earnings of mechanical engineers by type of industry, it will be noted that the median earnings for mechanical engineers in the railroad industry is about $2,000, with three years out of college or at 25 years of age, and increases to slightly over $3,000 after the engineer has been about 13 years out of college. The median curve then rises rapidly to slightly over $6,000, at which time the mechanical engineer employed by a railroad has been out of college about 24 years and is approximately 45 years of age. The median line drops to $5,400 at 50 years of age and increases again to $6,100 at 55 years of age.

Data Secured by Railroad Division Support Conclusions of Economic-Status Committee

The median earnings of mechanical engineers employed by the railroad industry and shown in the report of the A.S.M.E. Committee on the Economic Status of the Engineer are approximately the same as the median earnings shown in the report of the Railroad Division, A.S.M.E., Sub-committee on Professional Service. An abstract of the first report submitted by the Railroad Division committee, which was composed of mechanical engineers employed in the railroad and railway supply industries, was published in the February, 1927, page 93, issue of the *Railway*

Mechanical Engineer. A large part of the information with respect to earnings of mechanical engineers in the railroad industry, contained in the report by the Railroad Division, was obtained from a report of hearings before the Committee on Interstate Commerce, United States Senate, in 1921. The Senate Committee report only included salaries of $5,000 and over. Only a few of the salary figures given in the report were less than $5,000. The Railroad Division Sub-Committee on Professional Service did secure considerable data relative to the positions paying less than


1 New England
2 Metropolitan
3 Middle Atlantic
4 Southern
5 Middle Western
6 Prairie and Mountain
7 Pacific
8 U.S. Median Earnings
Dollars
Years Out 1-2 3-5 6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-
Age 23-24 25-27 28-32 33-37 38-42 43-47 48-52 53-57 58-62 63-

Comparison of 1930 median earnings of mechanical engineers by geographical location

$5,000, but was unable to check enough of these salary figures against individual careers to plot what it considered to be a proper median curve for all positions in the mechanical departments of railroads. As pointed out in the report, which was presented at a meeting of the Railroad Division in New York on March 14, 1928, data pertaining to earnings below $5,000 were too inadequate to plot an accurate curve showing median earnings below that amount.

The median earnings of mechanical engineers employed by railroads up to and including the position of chief of motive power was reported by the Railroad Division to be around $2,000 shortly after graduation from college; $4,300 ten years after graduation; $6,000 twenty years after graduation, and $6,600 thirty years after graduation from technical school. A comparison of median earnings shown in the reports of the A.S.M.E. Committee on the Economic Status of the Engineer and the Railroad Division Sub-Committee on Professional Service, shows the data to be essentially in agreement, and supports the conclusions arrived at by the A.S.M.E. Committee.

Salaries Do Not Decline With Age

The report of the Committee on the Economic Status of the Engineer states that engineering earnings do not decline seriously with age. Median earnings of men over 63 years of age practically equal those of men 48 to 52 years old. The lower boundary of the top ten per cent is as high at 63 years of age as it was from 53 to 57. Even the upper boundary of the lowest ten per cent, where the peak is reached at from 43 to 47 years, does not decline after 63 to substantially less than it was at from 33 to 37.

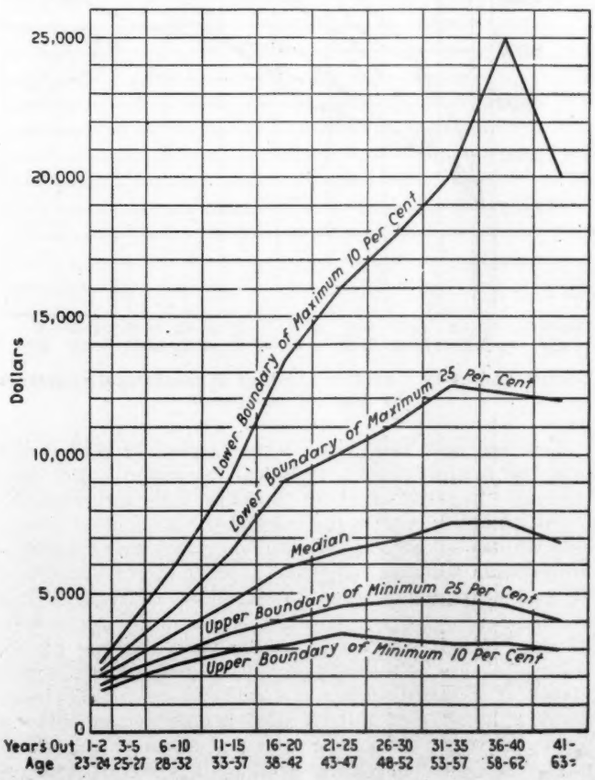
The maximum earnings at the upper boundary of men in the lowest ten per cent, it was pointed out, are earned by men between 43 and 47 years old; the maximum earnings at the lower boundary of the top ten per cent are earned by men from 58 to 62 years old. From the start, however, although the increase in dollars per year may be more, earnings at all salary boundaries generally increase at a slower ratio each successive year as men grow older, with a significant turning point in rate of increase between 35 and 40 years of age, as well as at the maximum.

Not only do salaries increase more rapidly in youth, but the rate of spread between the salaries of highly paid and low-paid men is greatest in early years.

What Engineers Earn on Different Types of Job

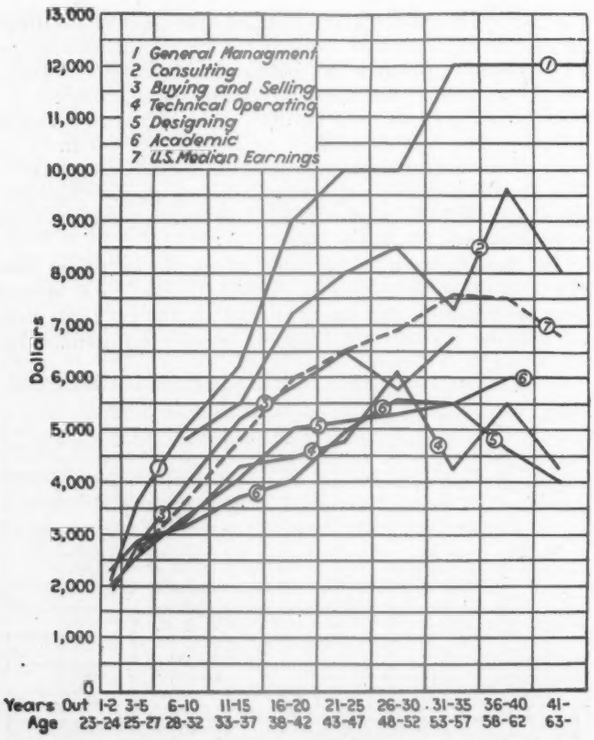
One of the charts gives comparative median earnings in the various sorts of work in which engineers engage. "Designing" includes all industrial research. "Technical operation" includes all maintenance, inspection, production control, and similar technical work relating to operation. "Consulting" as a type of job includes only actual consultants, and does not include consultant's employees as consulting as an industry does. "General management" includes all men in general executive work from assistant foremen up.

In classifying men by type of work an effort was made by the committee to include under each special type of work all the work of that character, regardless of whether the job could also be considered managerial,


Lower Boundary of Maximum 10 Per Cent
Lower Boundary of Maximum 25 Per Cent
Median
Upper Boundary of Minimum 25 Per Cent
Upper Boundary of Minimum 10 Per Cent
Dollars
Years Out 1-2 3-5 6-10 11-15 16-20 21-25 26-30 31-35 36-40 41-
Age 23-24 25-27 28-32 33-37 38-42 43-47 48-52 53-57 58-62 63-

Earnings of mechanical engineers during 1930 for the United States as a whole—Exclusive of salaries of teachers and federal employees

so that a man would not shift from one of the technical classifications to the general managerial classification merely because he progressed in his work to a position involving executive duties. For example, all men primarily concerned with industrial research or with the development of engineering design, even though they held such executive positions as chief engineer, or vice-president, were classified in the "designing" group. Similarly, all men primarily responsible for technical operation, including plant engineers and higher executives, were put in the "technical operating" group, regardless of the executive nature of their position. All persons directly related to sales or buying, from salesmen and buyers up through general purchasing agents, district managers, to vice-presidents in charge of sales and merchandising, were included in the selling and buying group. No one was put in the general management group unless his job was not only of a managerial character, but did not fall into any one of the special types of engineering work.



Comparison of 1930 median earnings of mechanical engineers by type of occupation

Teaching and those jobs where technical skill is the primary qualification ("technical operation" and "designing") are paid on about the same scale and throughout distinctly less than the median of the United States as a whole. Teaching shows a somewhat lower earning power than technical work between the ages of 30 and 40, and a distinctly higher earning power above 55. The median for buying and selling follows closely the median of the United States as a whole until the age of 45. After this age it falls distinctly below. Work which involves primarily either the capacity to handle independent businesses and to meet people as consultants, or the capacity to manage men and affairs as "general managers," is consistently well paid, general management especially soaring in earning power.

The relations between the median earnings of the different types of jobs also hold at other salary ranges, the differences becoming more emphatic, however, as higher wage levels are reached.

Managers, consultants, and teachers, show little falling off in old age, but designers, research men, and technical operating men, show an age drop after 50.

Not only is there this striking difference shown in the report between general management and consulting on the one hand, and design, research, and technical operation on the other, but there is a significant difference in earnings, especially among designers and research men, between those engineers doing technical work who have managerial duties and those who do not.

What an Engineer Can Do on Median Earnings

If median 1930 earnings are considered as the earnings of the typical engineer, and it is assumed in the report that the typical engineer marries at 26 years of age, and has two children at 30, the balance sheet of earnings and responsibilities on the 1930 basis will be about this: He will have about $2,700 to marry on; when his second child is born he will have about $3,500 with which to support his wife, his two children, and himself. When he is 45 and his two children are entering high school, he will have about $6,500 for his family income.

At the age of 50, 28 years after he himself was graduated from college, the committee estimates, he will have two children in college and earn about $7,000 a year. If he gives each child $1,000 a year for tuition and expenses, he will have $5,000 left to support his wife and himself. At sixty, with his children presumably self-supporting, he and his wife will have $7,500 a year to spend, but must look forward to a decline in earning power to $6,800 after sixty-three.

Where Earnings Are Highest

The New York Metropolitan district is reported as giving the highest median earnings at all ages below 63, but these are not substantially above earnings in the Middle Atlantic states except for men over 40, or the Middle West, except for men over 50. If the cost of living is taken into account there would probably be but little, if any, differential in favor of New York below that age, the report asserts. How much the sharp increase in earnings in New York City for men in the fifties is due to the calling to this city of leading men from other areas, it is impossible to determine.

In the Middle West, median earnings are slightly above the United States median until 50, after which there is a striking decline in earning power. The Middle Atlantic states, according to the report, fall behind the median of the United States at 40, but practically catch up at 55, and are well above the United States median at 65, although at the higher salary boundaries earnings remain low. Between 35 and 55 years of age, New England earnings are approximately $500 less than the median of the United States as a whole. After 60 they are nearly $800 less.

In the South, it is stated, young men under 35 earn well, but thereafter median salaries are consistently low, averaging over $1,000 below the United States median, but salaries at the higher boundaries are not below the country as a whole, even for men in their forties.

In the Prairie, Mountain, and Pacific states earnings are distinctly the lowest at all ages, except for salaries in the Pacific states for men between 38 and 42, who earn a little above the United States median, and salaries in the Prairie and Mountain states between 48 and 52, which equal those of the South.

A comparison of the data for type of job, shown in

(Concluded on page 448)

Krupp-Zoelly Turbine Locomotive Tested

*By R. P. Wagner**

Tests in fast-passenger service show economies in fuel and water—Figure of 14.25 lb. of steam per drawbar horsepower-hour lowest ever obtained on a steam locomotive — Fuel consumption was 2.3 lb. per horsepower-hour at 37.5 m.p.h.

WHEN, in 1922, the German State Railways contemplated ordering its first steam-turbine locomotive thorough study was devoted to the merits of the several designs then in existence. It was agreed that no higher boiler pressure should be used than in ordinary practice in order to obtain a clear result from the exclusive utilization of condensation, namely: from the lower end of the temperature drop. This conclusion was conservative but reasonable, as at the time no one knew anything about economically working exhaust turbines, and because the economy of the steam turbine was known to be inferior to the piston engine at high pressures, but considerably superior to them at pressures around and below the atmosphere.

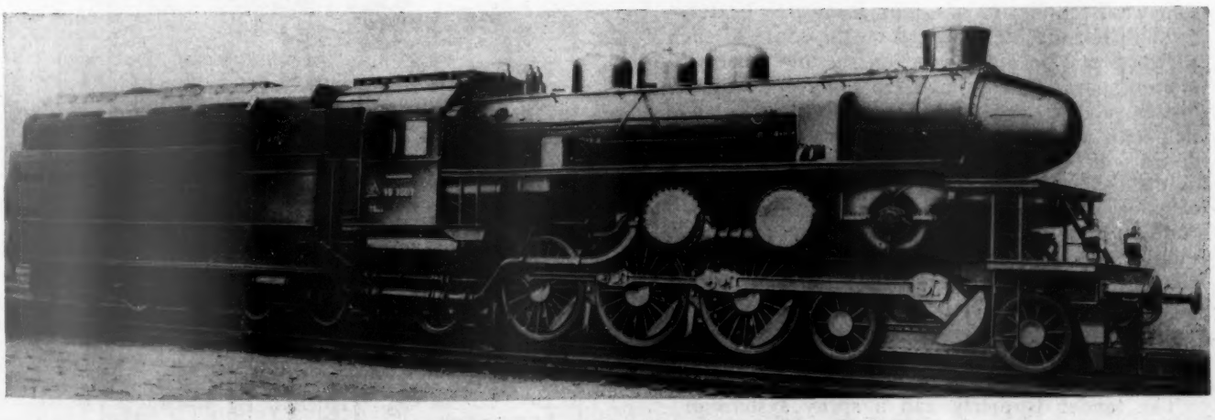
The necessity of condensation thus established, the novel elements of the locomotive were the turbine, the condenser and the air cooler for reclaiming the condenser water. The Ljungstrom system of condensing the steam by a dry stream of air meant a considerable saving in boiler water, as all the water of the engine circuit was condensed without any losses. But the condenser, due to the low specific heat of the air, required obviously an immense surface exposed to the air. Therefore more space and weight than was available on the locomotive proper. It also required, for forcing large quantities of air through the condenser, a fan of unusual capacity and of a greater steam consumption than seemed to befit any auxiliary engine. Moreover there was neither sufficient space on the engine nor weight allowance for the condenser. On the other hand, the placing of the condenser on the tender demanded imperatively that the turbine should be placed upon the same vehicle, as the pipe line for the exhaust steam leading from a turbine placed on the engine to the tender would have interfered badly with the vacuum and would have required a complicated flexible joint between the two, a joint hardly reliable in a vacuum line. For this reason Messrs. Ljungstrom arranged their turbine on the tender, next to the condenser. But this ingenious solution of the problem would hardly appeal to the railroad expert who does not care to see the locomotive pushed from the rear at high speed. This arrangement also included a flexible steam pipe under boiler pressure leading from the boiler to the main turbine on the tender.

* The author of this article is superintendent of the Locomotive Department of the German State Railways, Berlin.

The First Zoelly Turbine Locomotive

The design first brought forth by Dr. Zoelly, of Zurich, Switzerland,† opened another way towards a solution more palatable to a railroad man. The turbine was to be arranged on the locomotive in very much the same position as the ordinary locomotive cylinders, with water-cooled condensers closely attached to them. The condensers were, on the water side, supplied with ordinary feed water, which was taken from the tender and, after passing the condensers, was pumped back to the tender. This arrangement contained also a re-cooler for the cooling water, but it could easily be placed upon

† A description of the first Zoelly turbine-driven condensing locomotive appeared in the December, 1924, issue of the *Railway Mechanical Engineer*, Page 727. The Maffei turbine locomotive, No. 18-1002, which is being tested along with the Krupp-Zoelly locomotive, No. 18-1001, was described in the February, 1927, issue, page 78. Reports of the progress being made with the Krupp-Zoelly locomotive have appeared in a number of issues of the *Railway Mechanical Engineer* since 1924. This article, by Mr. Wagner, reports the progress and developments made on locomotive No. 18-1001 up to the present time.



Krupp-Zoelly turbine locomotive on the German State Railways

the tender and, as the condensing water would hardly be heated up to more than 140 deg. F., it could not deposit any scale in the condenser. Consequently raw water from the tender tank could be employed for the purpose.

In countries where water is scarce this cooling water could be re-cooled by air in a closed cooler like Ljungstroms', but this cooler would not have to contain a vacuum. This makes the design and maintenance of the many joints of such a cooler comparatively easy. In countries where water is abundant an open cooling system may be substituted for this type of closed air cooler, in which most of the heat is extracted from the water by evaporation. This process requires comparatively small fan capacity so that, roughly speaking, one quarter of the heat is absorbed by the air draft, whereas from 70 to 75 per cent of the quantity of water which is condensed in the clean-water circuit is evaporated and absorbs three-quarters of the waste heat.

Alterations to the Krupp-Zoelly Locomotive

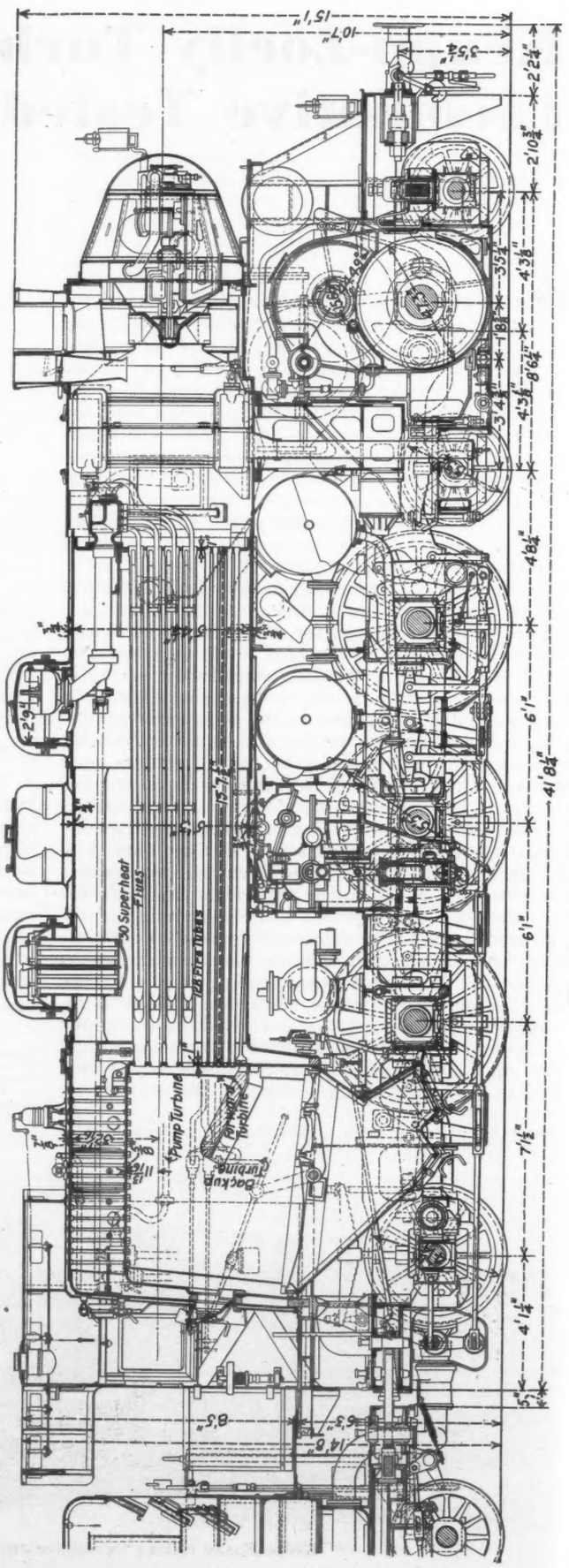
Because of its obvious advantages this system was chosen for the first test and a high-speed passenger locomotive of 2,000 hp. capacity was ordered from Fried. Krupp Aktiengesellschaft, the German licensees of the Zoelly system. It was finished for the Seddin Railway Exposition, which was held in October, 1924, and made some preliminary trips over the road. After that it was sent back to Krupps' and was there subjected to thorough stationary tests of the boiler and turbine, in which the side rods were disconnected and the jack shaft was connected to electric generators.

The result of these tests was that the system in itself proved entirely satisfactory. Besides some minor details, three parts of the system required major alterations to attain the economical limit for acceptance. These parts were the economizer, the turbine for backward motion and the water cooler on the tender.

The economizer, in which the boiler feed water was to be heated by combustion gases, was formerly placed crosswise the engine under the barrel of the boiler. The combustion gases, after passing the flues, were forced back from the front end through a square channel and, after passing the economizer, were returned to the front end and to the suction fan through another channel. This arrangement proved unsatisfactory and was replaced by an economizer in the front end shaped somewhat similar to a Coffin feedwater heater.

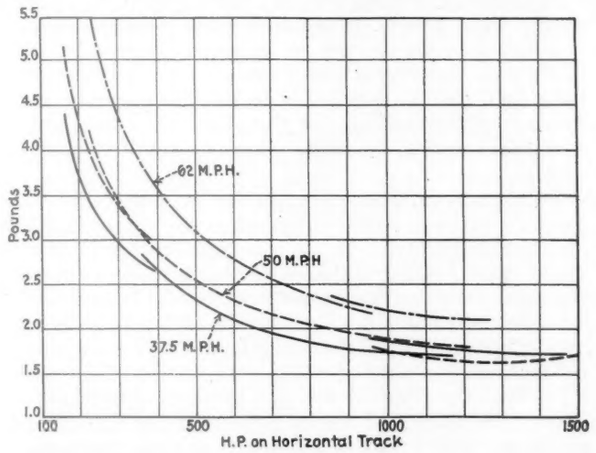
The back turbine mounted on the shaft of the forward turbine and acting during the forward motion somewhat like a rotary compressor moving in vacuum, consumed more power than anticipated. The rule for any future design deduced from the tests was that either the number of disks of this turbine (whose economy is not over-important) should be reduced to one or two or that instead of a back turbine a reversing gear should be provided. In the case of the existing locomotive it was resolved to retain the back turbine in its initial shape and to shut off its exhaust opening by a hand-operated shutter consisting of half-moon blades made of sheet metal. This alteration proved reasonably satisfactory.

The tender formerly had a spray system in which the drops of water fell a considerable dis-



Elevation of the Krupp-Zoelly turbine locomotive

tance to afford sufficient contact with the air blown upwards. Considerable water was entrained by the air and caused a shower to fall on the coaches behind the locomotive. Another sprinkler was therefore employed, in which the water drips into layers of Raschig rings arranged on perforated trays. These rings are designed to provide a large surface to the water and air. Scarcely any water is entrained with the present system, as it



Coal consumption per horsepower-hour at the drawbar

clings to the ample surfaces provided. This alteration did away with most of the trouble.

On completion of these changes in construction, the locomotive was subjected to thorough road tests by the testing department of the German State Railways, which is in possession of several complete dynamometer cars. These tests proved that the guaranteed fuel limit was attained. Moreover they proved that this turbine locomotive is at present the most economical locomotive on the system, whatever may be said about the complications necessary to obtain the result. The locomotive was formally accepted and assigned to the Essen division, where it hauls fast passenger trains between Hanover and Aix-la-Chapelle.

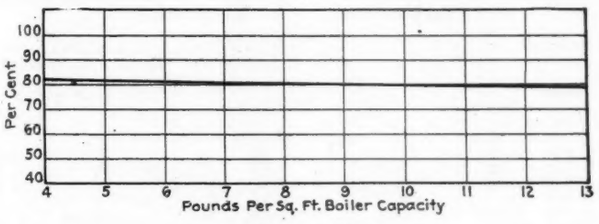
Features of Construction and Performance

The Krupp-Zoelly locomotive is a Pacific type with a permissible weight on each wheel of about 22,000 lb. The boiler is similar to the ordinary German locomotive boiler but for two exceptions:

First, the grate area and the heating surface seem smaller than suitable for a boiler of 2,000 hp.; the anticipated saving of never less than from 10 to 12 per cent of the heat accounts for this fact.

Second, the boiler is not equipped with a feed dome as is German practice, because the feed water makes a closed circuit and is pure when it enters the boiler. Instead of the feed dome another steam dome is arranged on the back course which serves an unusual purpose. As it would be wasteful to use water from the closed circuit for heating purposes a small boiler holding raw water for train heating is placed in this dome and exposed to the steam of the main boiler. The drop in temperature is sufficient to maintain in the heating system the regulation pressure of 70 lb. per sq. in. The small quantity of pure water required for making up losses in the closed circuit (for leakages, fan turbine and safety valves blowing off, altogether from 3 to 5 per cent), is also taken from this boiler after being purified of scale-forming material.

The front end is essentially different from conven-

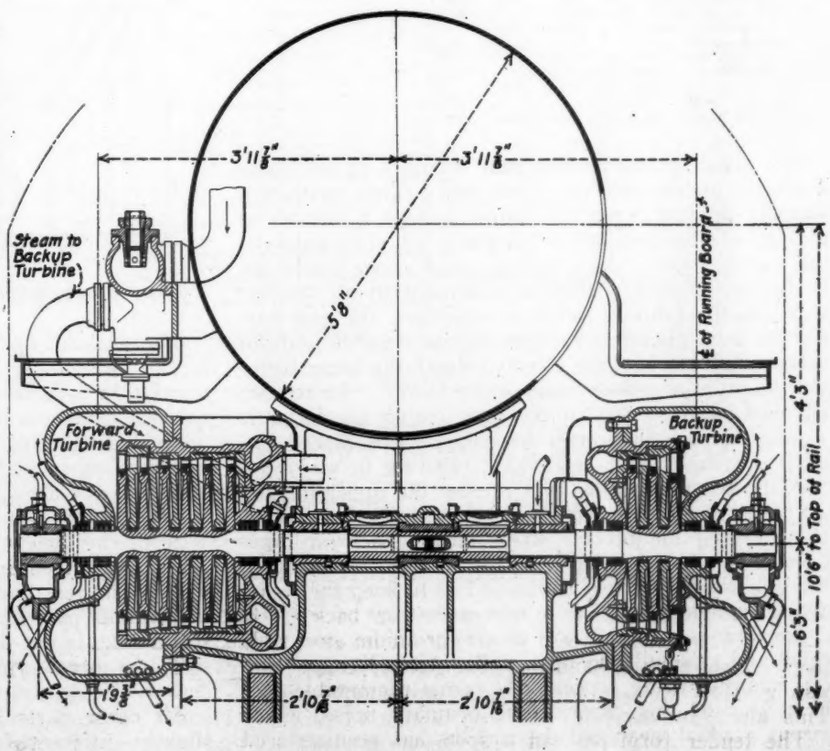


Boiler efficiency

tional design. The ring-shaped economizer is placed ahead of the superheater header and the cylindrical opening in its center is closed by means of a removable diaphragm, so that the gases are forced through the ring chamber, where they hit against the water pipes.

After passing the economizer, the gases are sucked into a fan driven by a steam turbine and discharged through the fore part of the stack. Another stack, smaller in diameter, is placed behind this stack, through which the gases are discharged by a blower when the locomotive is standing and the fan is not running. At other times this stack is closed by a diaphragm. The fan is inserted in the front door and swings out with it.

The other auxiliary on the engine serves chiefly the



Cross section through the turbines

Elevation of the Krupp-Zoelly turbine locomotive

boiler and the condenser. A geared steam turbine is arranged between the frames below the back course of the boiler. It drives a two-stage boiler feed pump, a rotary pump for the circulation of the cooling water for the condenser, the air compressor and the small pump which delivers purified water into the closed circuit. Both feed pumps have been designed as piston pumps, as in the case of a leaky boiler check, a rotary pump would allow boiler steam or water to enter the vacuum reservoir.

Dimensions, Weights, and Proportions of the Krupp-Zoelly Turbine 4-6-2 Type Locomotive

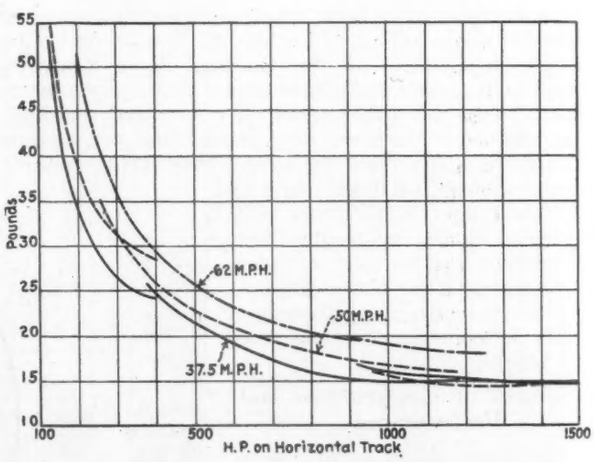
Railroad	German State Railways
Builder	Fried Krupp Aktiengesellschaft
Service	Experimental passenger
Type of locomotive	4-6-2
Road number	18-1001
Maximum speed	68 m.p.h.
Weights in working order:	
On drivers	130,900 lb.
Total engine	247,500 lb.
Tender	155,000 lb.
Total engine and tender	402,500 lb.
Wheel bases:	
Rigid	12 ft. 2 in.
Total engine	32 ft. 6 in.
Wheels, diameter outside tires:	
Driving	65 in.
Trailing truck	49¼ in.
Front truck	39¼ in.
Boiler:	
Steam pressure	213.3 lb.
Fuel, kind	Soft coal
Flues, number and diameter	30—4-15/16 in. and 5¼ in.
Tubes, number and diameter	128—1-3/16 in. and 1½ in.
Grate area	33.4 sq. ft.
Heating surfaces:	
Evaporative	1,668.5 sq. ft.
Superheating	710.4 sq. ft.
Combined superheat and evaporative	2,378.9 sq. ft.
Turbine and condenser:	
Revolutions of main turbine	8,000 r.p.m.
Ratio of gear between turbine and jack shaft	1:24.3
Condenser surface	2,368.15 sq. ft.
Tender:	
Water capacity	4,500 gal.
Fuel capacity	6.5 tons
Wheels, diameter outside tires	39¼ in.
Tractive force	27,500 lb.
Weight proportions:	
Weight on drivers ÷ total engine weight, per cent	53
Weight on drivers ÷ tractive force	4.76
Total weight engine ÷ comb. heat surface	104.2
Boiler proportions:	
Tractive force ÷ comb. heat. surface	11.68
Tractive force × diam. drivers ÷ comb. heating surface	758
Combined heating surface ÷ grate area	71.2

The main turbine and its gear occupies all the space available underneath the front end. This equipment extends down between the frames in such a manner as to compel the designer to displace all vital parts of the engine truck. As a turbine gear casing could not be designed strong enough to withstand all the stresses to which the cylinder saddle is subjected, the gear casing has been placed as far forward as possible with an independent steel casting closely behind, the latter forming the front-end boiler support or saddle. To remove all outside stresses from the gear casing the latter is suspended in both frames by side pinions placed immediately back of the jack shaft. During forward motion, the reaction of the gear presses the upper part of the casing against the saddle piece, to which it is bolted to withstand the reverse stress during backward motion. The turbine casing is partly cast in one piece with the gear casing but it is so divided as to keep the steam away from the gear.

The gear is made of hard nickel-chromium steel with small and close-pitched teeth milled after Krupps' special manufacturing process. It seems remarkable that in a gear of this capacity the ordinary noise, which means gradual wear and destruction, has been reduced to a fine humming tone. Force-feed lubrication for all bearings and for the gearing, which is supplied by an independent pump makes a safe but complicated detail as compared with ordinary cylinder lubrication.

The inside of the engine truck was to be kept entirely free for the lower part of the gear casing. The center pin was shifted backwards and fastened in the casing. The truck frame has been designed trough-shaped all around the latter. The rear set of wheels is equipped with two independent bearing springs, whereas on the front wheels, to obtain a three point suspension, a single bearing spring is arranged crosswise. Although all theoretical requirements of a leading truck have been met, it appears to be heavily inconvenienced by the position and size of the gear, and even a minor derailment would be likely to prove fatal to the gear casing.

Both main turbines are mounted on one shaft. The forward turbine, which is placed at the right-hand side of the locomotive, is a six-stage turbine of the Zoelly type. The first disk is fed by two sets of nozzles designed for a feed of, respectively, 6,700 lb. and 13,400 lb. of steam per hour. By bringing both sets of nozzles into action at a time the weight on the drivers can be fully utilized in starting or on steep grades. The boiler is sufficiently dimensioned to produce 20,000 lb. of steam. All stages of power between these three nozzle positions (which may be compared to three positions of cut-off) have to be reached by throttling the steam pressure in the dry pipe, a process still open to improvement.



Steam consumption per horsepower-hour at the drawbar

The back-up turbine is located on the left side. It is a three-stage turbine with only one set of nozzles, as backward motion is comparatively rare. The exhaust chambers of both turbines are connected by a wide vacuum pipe in front and have, on both sides, a direct short exhaust into the front condensers, as shown in the drawing on page 445.

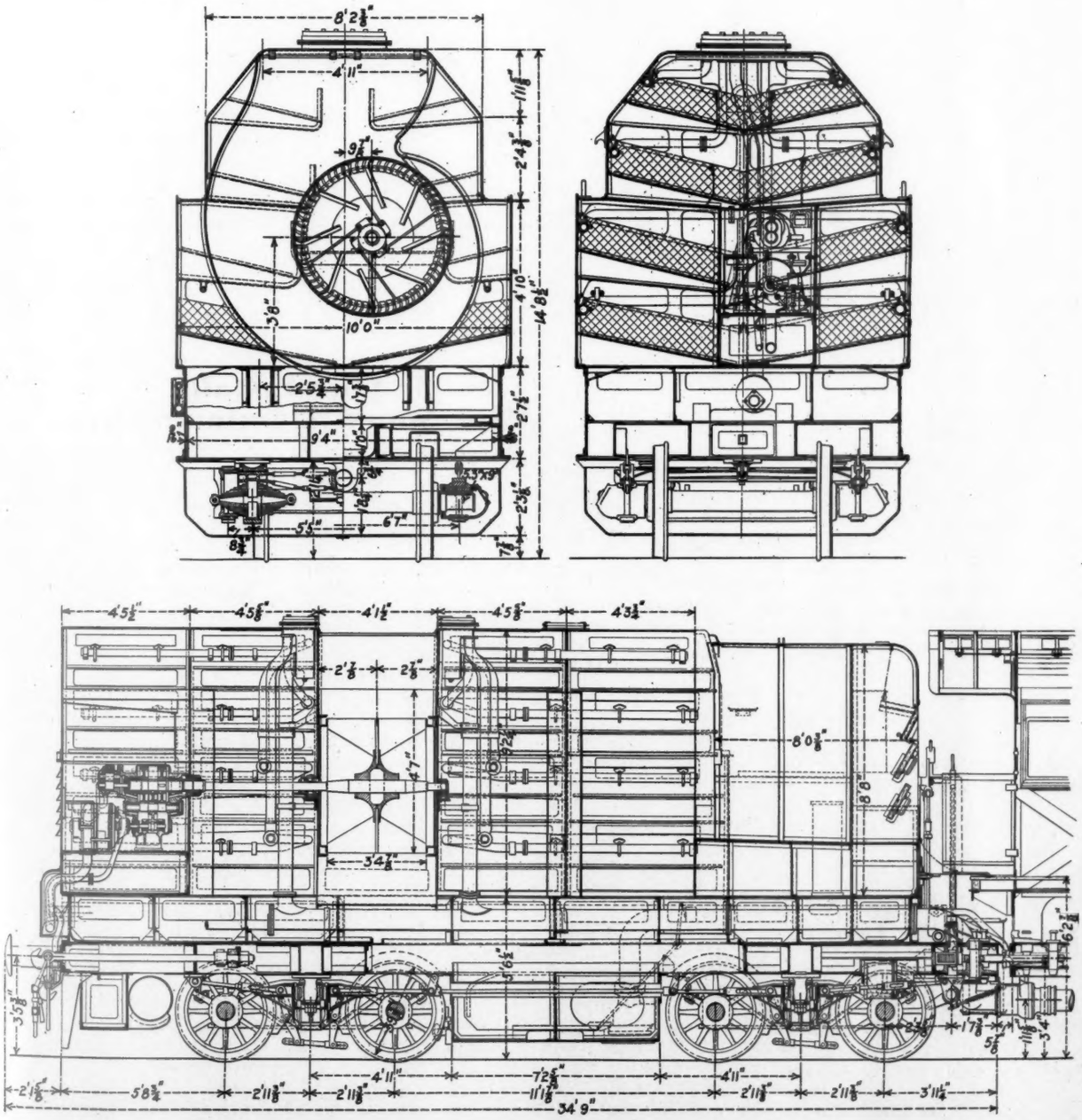
Both water-cooled condensers are arranged crosswise of the locomotive between the boiler and frames. The front condenser is just ahead of the leading coupled wheels, the rear one is located between the leading and the second pair of drivers. The latter unit, on the steam side, is not directly connected with the turbines, so that it merely receives the overflow of the front condenser.

All other parts of the locomotive proper are but slightly different from ordinary locomotive practice. The frames are of the bar type, made, according to

German practice, of rolled 4-in. plates and machined throughout. The coupled wheels are remarkable for the smallness of their diameter, 65-in., as compared with maximum speed 68 m. p. h. This diameter was admissible as no reciprocating parts are included in the system. On the other hand the momentum of the revolving parts, especially because of the turbine and gear wheels, was increased to such an extent that the weight on the trailer wheels had to be utilized for braking purposes, which is otherwise not German custom.

used for train heating and for feeding the closed circuit. As this consumption should not be more than three quarters of the water consumption of an ordinary locomotive a tank holding 4,500 gal. was considered sufficient. The fuel supply is contained in a closed bunker and amounts to 6.5 tons of coal. The larger portion of the tender is occupied by raw water cooling equipment.

The center of the cooler is a powerful low-pressure fan with horizontal shaft. This fan is driven by a geared steam turbine, which receives its live steam



Elevation of the tender and cross sections showing the low-pressure fan and arrangement of trays in the cooling chambers

The jack shaft drives the leading coupled axle by means of two side rods placed at 90 deg.

The tender, which is heavier than ordinary tenders, is carried on two four-wheel trucks and is entirely enclosed. The raw water supply is partly evaporated, part supply from the locomotive boiler through a flexible pipe connection and discharges its exhaust steam through a similar pipe into the feed-water header.

The fan draws air through the cooling chambers which are provided with four trays, one above the

other. These trays have perforated bottoms, through which the air is drawn into the fan. Each tray is filled with a layer of Raschig rings. These patent rings are an ingenious device for providing large surfaces without requiring much space. They consist of pipe cuttings, whose length is equal to their diameter. When arranged loosely in a layer, they provide many irregular air channels, which deflect the air and bring it in close contact with all inside- and outside-ring surfaces. These surfaces are thoroughly wetted by the warm water sprayed into the ring layer from a perforated discharge pipe which is placed immediately above. The air, saturated with moisture, is delivered to atmosphere through an opening in the roof of the tender.

All of the tests made with this locomotive were made on the road. The figures for steam and fuel consumption per drawbar horsepower-hour were influenced slightly by the varying air resistance. At a speed of 37.5 m.p.h. the steam consumption of the locomotive was 22 lb. at 500 hp. This consumption decreased to 16 lb. when the locomotive was exerting 1,000 hp. at the drawbar. At a speed of 50 m.p.h. the steam consumption at 500 hp. was 23.5 lb. which was decreased to 18 lb. at 1,000 hp. At 62 m.p.h. the locomotive used 26 lb. of steam at 500 hp. and 21 lb. at 1,000 hp. The boiler efficiency of 81 per cent showed the favorable influence of using pure water on heat transmission. The efficiency of 81 per cent was obtained at one-third of the normal load, and the efficiency curve dropped at a remarkably slow rate to 79 per cent at full load. The general trend of boiler efficiency, with the draft produced by a fan, is similar to that of the boiler of a reciprocating locomotive, and proves that the combustion and boiler efficiency are not influenced by the number and nature of the impulses from the exhause nozzle, but depend solely on the rate of combustion and the velocity of the combustion gases.

Curves showing the steam consumption at 37.5 m.p.h., 50 m.p.h. and 62 m.p.h. were somewhat unusual owing to the fact that steam is admitted to the turbine either through the small set of nozzles, through the large set, or through both sets of nozzles. The figure of 14.25 lb. of steam per drawbar horsepower-hour is the lowest ever obtained on a steam locomotive. The fuel consumption per horsepower-hour at 37.5 m.p.h. was 2.3 lb. at 500 hp. at the drawbar and 1.7 lb. at 1,000 hp. At a speed of 50 m.p.h. the locomotive consumed 2.6 lb. of coal at 500 hp. which decreased to 1.8 at 1,000 hp. At 62 m.p.h. in exerting 500 hp. at the drawbar the coal consumption was 3.1 lb. decreasing to 2.25 lb. at 1,000 hp.

A.S.M.E. Reports Railroads Pay Low Salaries

(Continued from page 442)

the report, with those of different industries indicates that while academic institutions pay less than almost any other class of employers, the earnings of teachers compare favorably with the earnings in the technical branches of engineering. It also indicates that the differences between types of industries are relatively small compared with the differences between types of work. Apart from teaching and railroads, it is pointed out, it makes relatively little difference what industry a man goes into. There is little question that the highest salaries in the design and technical operation groups themselves, the report states, are received by men whose work is largely of an executive nature, such as vice-president in charge of design and chief engineers.

The survey committee concluded that a good education is "worth while," stating that, apart from railroads and academic institutions, the differences between industries as regards salary opportunities are not great at most ages.

The differences in earning power between men whose work is exclusively technical and those who combine with their technical ability the capacity to handle independent businesses or to manage men or affairs, are great—so great as to indicate the importance of most engineers' seeking to develop themselves in this respect, and of engineering schools bending their curricula somewhat toward this end.

The report was signed by Conrad N. Lauer, (chairman) president, Philadelphia Gas Works, Philadelphia, Pa.; C. F. Hirshfeld, chief of the research department, Detroit Edison Company, Detroit, Mich.; Dexter S. Kimball, dean of the College of Engineering, Cornell University; Henry B. Oatley, vice-president in charge of engineering, Superheater Company, New York; Col. William A. Starrett, president, Starrett Corporation, New York; Herbert L. Whittemore, chief of the Engineering Mechanics Section, Bureau of Standards, Washington, D. C.; William Elgin Wickenden, president of the Case School of Applied Science, Cleveland, Ohio, and James M. Todd, consulting engineer, New Orleans, La.

Electric Line Installs High-Speed Aluminum Cars

(Continued from page 439)

sheets with proper baffle plates, pipe connections, etc. The tank is welded, as are the baffle plates and pipe connections. Continuous basket racks are located on each side of the car, being made of aluminum castings and tubing. The aluminum pressings were all made without heating the sheets. The pressings aided in eliminating rivets and welding. The largest item of welding was the joints between the side posts and end posts and the window sills, welded by the metallic-arc process.

Equipment supports under the car are all-aluminum forgings or pressings, formed cold. A pilot is provided under the front end of the car, which is made of aluminum angles and tubing. The angles, made of strong-aluminum alloy, contain several sharp bends which required practically a forging operation. This was conducted at about 300 to 400 deg. F., in order not to affect the physical properties of the material. The angles were heated in this instance in a special furnace out of direct contact with the frame to prevent overheating and oxidation. Tubing used in the pilots was made of soft aluminum and worked cold. In connection with this light forging work, another notable characteristic of aluminum was observed in its much greater heat-conductivity than steel, this characteristic being helpful in rapidly dissipating heat from the application of hot steel rivets so that the heat has a purely local effect, if any, on the physical properties of the strong-aluminum alloys.

ADDING INSULT TO INJURY.—Just how quiet things are these days along the railroads is indicated by a report from Hobart, Ind., that a ring-necked pheasant has located her nest within a few feet of the Pennsylvania main line at that point, and another from Augusta, N. J., to the effect that a robin has built a nest and raised a family in the air-brake compressor of one of the Lehigh & New England's gasoline locomotives. We have been aware that the railroads are not getting as much business as they would like to have, but it is discouraging to know that they are so idle that birds are building nests on them.

Cutting Costs In the Coach Yard

THE coach yard is too often looked upon by mechanical officers as a sort of necessary evil and when the budgets are made up for improvements this part of the car department usually gets nothing at all or is obliged to get along with home-made equipment that is of little assistance in performing the work. The very nature of the work demanded of the coach yard is such that it should be worth while to install time saving equipment in order to speed up the work at important terminals. Consideration is rarely given to the fact that modern facilities especially designed for coach yard use will not only save a lot of time but will result in substantial economies in operation and maintenance as well.

With the idea of finding out just what could be accomplished along these lines a survey was recently made of the conditions existing in a number of coach yards in different parts of the country and it may be said that there has been practically no effort made to modernize the operation of this phase of car department work. In order to give some idea of the possibilities of utilizing modern equipment, examples are presented in this article of the methods and facilities used in a coach yard handling an average of 125 cars a day. Cost figures are included to show the cost of performing the work by the now obsolete methods as compared with the lower costs with modern facilities. At no one point did actual installations provide a complete example of all the facilities mentioned in this article so that it has been necessary, for purposes of comparison, to take the figures under the older methods and estimate the cost of doing the work in the same yard with the new equipment using actual known costs obtained from railroad coach yards in which such new equipment has been installed and operating for some time.

In a coach yard handling 125 cars daily the distribution of the cars according to type is as follows:

Type	No. of cars	Percentage
Pullman	39	31
Diners	10	8
Mail	11	9
Baggage and Express	16	13
Coaches	49	39
Totals	125	100

Passenger Car Repairs

Ordinarily the principal jobs that have to be performed in the normal operation of making running repairs to passenger cars are those of changing wheels, adjusting the height of couplers by shimming the springs and center plates, changing bearings and bearing wedges and numerous other miscellaneous items on the trucks and underframe where it is necessary to raise the body of the car. In most coach yards, hand-operated jacks are used at the present time to raise and lower the cars and, in the majority of instances, inadequate home-made drop-pit jacks are used for removing wheels. In order to handle the above mentioned repairs on 125 cars a day (with the men working on two shifts) the daily labor costs, with the old type of equipment, amounted in one case to $129.60 or an average of $1.04 a car. This average cost per car, it might be explained, is arrived at by taking the entire amount spent for work of this type on all cars in any one day, week or month and dividing this total amount by the total number of cars which received any repairs of this nature during the same period. The use of modern air-motor-driven hoists and electric drop tables has materially simplified the task of doing work of this kind, and, in one yard, an investment of $5,100 in new equipment made it possible to reduce the daily labor cost for this kind of work to a figure of $90.72, or 74.69 cents per car. It might be added that these latter figures include interest at 6 per cent, depreciation at 10 per cent and a reasonable allowance for maintenance on the new equipment. On the basis of the above figures, the annual cost for repairing cars under the old method is $47,450 while, with the new equipment, it would be $34,077, or a saving of $13,373 a year.

The installation of modern equipment for washing cars and making repairs will pay for itself in a short time

The Cost of Cleaning Cars

In practically all the coach yards of this country, large or small, the work of cleaning both the exteriors and interiors of all types of passenger train cars is a job requiring a maximum of manual labor. Within the past few years car washing and scrubbing machines have been designed and installed at some coach yards which make it possible to take a train of from 10 to 15 cars as they are received from the passenger station and run them through the washing and scrubbing machines. These machines make it possible to keep the painted surfaces of the cars in much better condition than when the cars are scrubbed and washed by hand. Cars which have been through the washing and scrubbing machine several times and which are regularly serviced by this newer method of cleaning present a much neater appearance in trains than those which are cleaned by the most careful of hand methods. In one yard which handles about 125 cars a day, the average labor cost of cleaning the exteriors of cars (exclusive of trucks) is 70.8 cents per car plus a charge of 8.2 cents per car for supplies, making a total cost of 79.0 cents per car. At the rate of 125 cars a day, it is necessary to clean 45,625 cars a year at a total cost of $37,044. The installation of a modern mechanical car washing and scrubbing machine, involving an investment of approximately $8,000, would reduce the average cost per car cleaned to 46.66 cents, or an annual total of $21,289. This latter figure under the machine methods of cleaning indicates that the installation of the machines results in a saving of $15,755. Into the cost of machine cleaning is figured interest, depreciation and

maintenance on the washing machine, the necessary supplies, power and water as well as the time required for a switching crew to handle the cars through the machine.

There is a possibility that in some instances an electric car puller could be used more effectively to handle the cars through the washing machine, thereby making a substantial reduction in the cost per car. This would, of course, depend upon the layout of the coach yard. Where the yard is so situated and the washing machine so located that the cars can be run through the machine as they enter the yard without additional handling from the station it would, of course, be more economical to make use of the switching locomotive. The estimated cost of moving cars with a car puller, including interest, depreciation, maintenance on the machine and attendant labor required, is approximately 6.5 cents per car as compared with 14 cents for moving with a locomotive.

Interior Cleaning

Where cars are cleaned by hand methods, a study of the costs in a yard handling 125 cars a day indicates that the actual cost for 86 cars (the interiors of Pullman cars are cleaned by Pullman Company forces) is 42.17 cents per car. These costs include all hand sweeping, dusting, brushing, beating the dust out of the seats and blowing out the interior of the cars with air. It also includes the cleaning of the carpets, plush seats and seat backs with a home-made air suction outfit. On the basis of handling 86 cars a day, the annual cost of cleaning cars by hand methods amounts to $13,237.

On one road which has recently changed over to a complete vacuum cleaning system for handling this work, it is reported that the costs per car have been reduced 22 per cent. The coach yard is equipped with one four-outlet portable electric vacuum cleaning machine fitted with special nozzles and brushes for cleaning mouldings, side walls, floors, ceilings, curtains, carpets and seat plush. The investment required for the installation of such a vacuum cleaning system is approximately $3,000. On the basis of 86 cars a day, at 22 per cent saving, the cost of car cleaning would be reduced to 32.89 cents per car or $10,624 a year, indicating an annual saving of $2,613.

Icing Passenger Cars

Another job in the coach yard on which modern equipment can undoubtedly save money is that of icing passenger cars. Under the present system in use in most coach yards, ice is loaded in a small four-wheel ice truck having a capacity of about 500 to 1,000 lb. (enough to ice 10 to 16 cars). These trucks are pulled by hand from car to car while the cars are being iced. Ordinarily, two men handle a truck and fill the individual ice buckets which are placed on the car platforms for the inside men to handle to the coolers. Two men can average about 15 cars an hour, including the time it takes to go to the ice storage and fill the trucks. At current wage scales, this cost will figure out to about 8.53 cents per car. If an electric truck, involving an investment of approximately $2,200 is used for this work, the truck can handle three trailers of ice at one time, which is sufficient for the icing of from 30 to 50 cars. This eliminates two trips out of three to the ice storage for refilling the trucks—each of which usually consumes about 20 minutes when the work is done by hand. Owing to the greater speed at which the electric truck can operate, a time-saving of approximately 20 minutes can be added to the 40 minutes saved by eliminating the trips for refilling the trucks, thereby making a total saving of approximately one-third of the time required. With the electric truck, cars can be iced at the rate of 20 an hour and the cost, including labor, interest and depreciation on truck investment, and truck operation and maintenance will be 5.4 cents a car.

The savings by the electric truck method in a yard handling 125 cars a day, an average of 109 of which are iced, would amount to 3.13 cents per car or an annual saving of $1,245 a year.

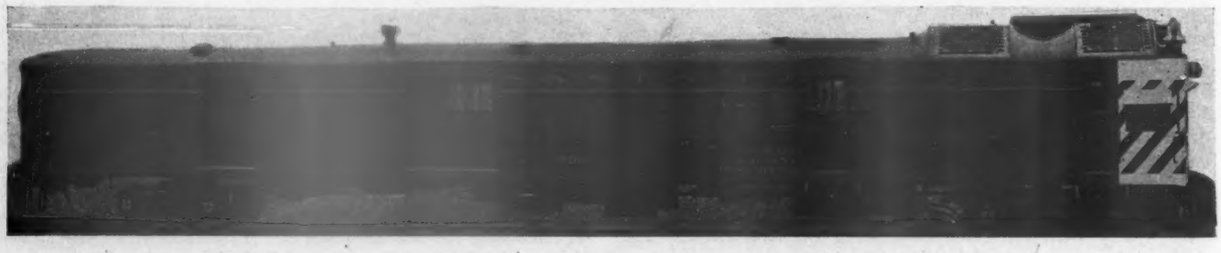
After considering the potentialities of a modernization program from a dollars and cents standpoint, it is evident that many of the so-called non-revenue departments on a railroad can make a real contribution toward the reduction of operating expenses if given the facilities. In Table I is shown a summary of the costs, investment necessary and the savings as outlined in this article. Modern industrial plants during the past few years have been inclined to replace obsolete machinery where that equipment will pay for itself within a reasonable length of time. The railroads have made many economy producing investments which would not pay for themselves in less than four years, yet, the summary of the savings outlined in Table I indicates that it is possible to install in a coach yard modern equipment now available which will result in sufficient savings in maintenance expenses to pay for the new equipment involved in less than seven months.

Table I—Summary of Costs, Investment and Savings

Items	Old methods	New methods	Investment	Savings
Car Repairs	$47,450	$34,077	$5,100	$13,373
Exterior Cleaning.....	37,044	21,289	8,000	15,755
Interior Cleaning.....	13,237	10,624	3,000	2,613
Icing Cars	3,393	2,148	2,200	1,245
Totals	$101,124	$68,138	$18,300	$32,986

NEW DIESEL LOCOMOTIVES IN GREAT BRITAIN.—Three new Diesel-electric locomotives recently completed in England are being tested on British railways according to reports received by the United States Department of Commerce. Power for the motors is supplied by generating units driven by Diesel engines and it is estimated that under normal conditions they will run for nine hours on one ton of heavy oil.

* * * *



Santa Fe rail-motor cars recently placed in service have the front ends striped in black and white to assist motorists to "hear the train coming"

Freight Locomotive Designed For Bad-Water Territory

Canadian National builds a sample 2-8-2 type locomotive for test in fast-freight and tonnage service on the Western Region—Designed to overcome difficulties experienced with sludge and boiler sediment being carried over into the superheater units and cylinders

OPERATING conditions are encountered on the Western Region of the Canadian National in the prairie provinces which render locomotive maintenance costly, due primarily to the poor quality of feedwater available. When new freight power was being considered for this region, it was decided to build a sample locomotive in which features were embodied that would tend to relieve these conditions.

Most of the difficulties experienced have been due to sludge and boiler sediment being carried over by the steam flow into the superheater units and cylinders, and by the burning out of firebox sheets.

A locomotive, to meet the above conditions, must provide some method of collecting and conveying steam to the cylinders different from that usually employed, must have a relatively slow rate of combustion, high boiler capacity and steam distribution of a nature such that full capacity can be developed without unduly forcing the machine as a whole.

With these conditions in view, the company designed and built at its Point St. Charles shops, Montreal, Que., locomotive No. 3800, Class S-4-a, and, on completion in the early fall of 1930, placed it in service on the Central Region for observation and test between Danforth, Ont., and Sarnia, Ont., in fast-freight service and, later, between Danforth and Fort Erie, Ont., in heavy coal service. Under both classes of operation the locomotive has demonstrated its ability to perform in a satisfactory manner and considerable valuable experience is being gained for incorporation in further designs at a future date. Several minor alterations have been made to the original design as the result of the preliminary test runs.

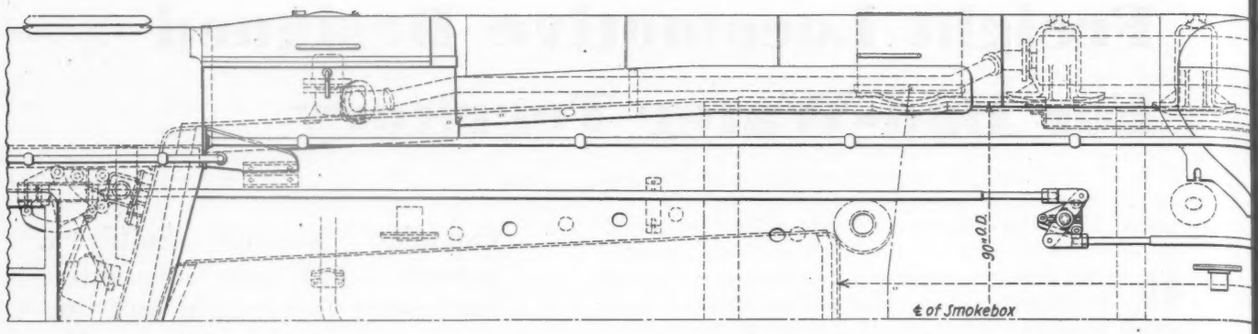
The No. 3800 exerts a tractive force of 56,200 lb. It has 24-in. by 30-in. cylinders and operates at a boiler pressure of 265 lb. The driving wheels are 63 in. in diameter. The locomotive weighs 337,200 lb., of which 237,000 lb. is carried on the drivers.

Boiler Construction

In accordance with the requirements referred to in the preceding paragraphs, the dome and inside dry pipe have been omitted from the boiler and an outside dry pipe of somewhat novel design introduced in their stead. On the top center line of the boiler at suitable intervals three 5½-in. holes are cut to provide an outlet for the steam. Over these openings are riveted cast-steel saddles, consisting of a base and a cylindrical body portion, the forward two of which are open at both ends, while the rear is open on one end only. The other end is cored and faced for a ball joint. The collector pipe, a 10¾-in. seamless steel tube, is passed through the cylindrical saddles and bottomed on a faced joint on the inside of the solid head of the rear saddle. These saddles are of such shape that an annular passage is formed between the collector pipe and the cylindrical shell, terminating at the bottom or base portion in a hole which registers with one of the 5½-in. holes in the boiler shell. The open ends are faced and bored to a sliding fit for the pipe and made steam tight by means of electric welding around the outside faces of the saddles and the collector pipe.

Around the periphery of the collector pipe at the portion covered by each of the saddles are drilled five rows of ⅝-in. holes, 20 in each row, making a total of 100 ⅝-in. holes, to conduct the steam from the 5½-in. boiler outlets to the interior of the collector pipe. The forward end of this pipe is swedged down to receive an 8-in. outside diameter seamless steel dry pipe which is securely welded at its rear end to the swedged portion of the collector. The dry pipe terminates at the smokebox end in a steel flange which is welded to the pipe and faced for a ball-joint connection to the shut-off valve. A cast-steel L-shaped shut-off valve body, provided with ball-joint flanges, passes through an open-

Canadian National 2-8-2 type locomotive built for freight service on the Western Region



Section of boiler showing

ing in the smokebox immediately in front of the circumferential seam, the vertical leg of which connects with a horizontal flange on the superheater header, while the horizontal leg is fitted to the dry-pipe flange. The shut-off valve, a flat disk of plate bored in the center to form a seat for the balancing valve and actuated by an Acme threaded screw, the initial movement of which unseats the balancing valve, has its seat on a forged-steel ring pressed into a suitable recess at the top of the vertical leg of the shut-off valve body. Faced lugs on the sides of the valve body are fastened by suitable anchor plates secured to the smokebox shell to relieve the body casting and dry pipe of any end thrust due to steam pressure.

Inside the boiler, immediately under the outlet openings, a shallow box of ¼-in. plate is tightly fitted to the shell and held in place by studs. The bottom face of this box or pan is perforated over the greater portion of its length with 468 ⅝-in. holes of an extruded form, through which the steam must pass before having access to the outlet holes.

It was anticipated that, by spreading the steam-outlet area over a large extent of water surface in this way and baffling any sludge or entrained water by means of the extruded form of the perforations, some of the difficulties experienced could be overcome.

However, these expectations have not been entirely realized in service and the box or pan has since been altered.

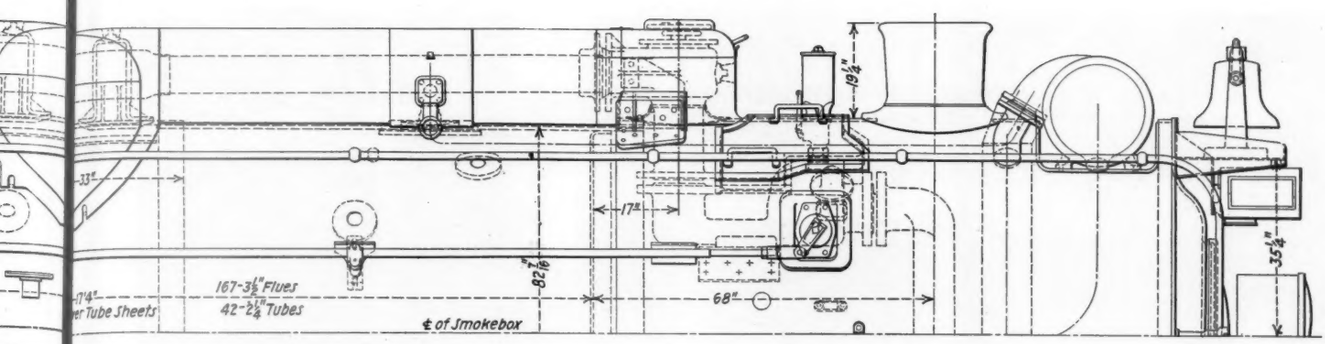
In addition to the alteration made to the pan under the dry pipe and changing the feed pump, the front outlet hole in the boiler has been blanked off and the remaining two holes have been found of sufficient area to meet the steam requirements of the cylinders and auxiliaries in a satisfactory manner. While using the three openings, the locomotive showed a tendency to carry water and sediment into the dry pipe, especially during periods of surge such as follows a heavy brake application. Since the front opening was blanked, no further difficulty has been experienced and dry steam with a high degree of superheat is consistently maintained.

A 2½-in. iron pipe with flanged connections runs from the back end of the rear collector saddle to the cab turret on the right side. This pipe supplies saturated steam to a number of auxiliaries. The superheated-steam turret connects to a 2½-in. pipe which is carried along the top of the running board on the left side to a cast-steel auxiliary steam-pipe elbow passing through the smokebox near the top and connected directly to the superheater header.

A 13-in. by 15-in. manhole provides access to the interior of the boiler. This manhole is located on the top center line at the rear of the collector saddles and is closed by a cast-steel cover into which the safety valves are screwed. The dry pipe, collector pipe and saddles are lagged and jacketed and an external inverted U-shaped casing is fitted from the stop valve at the smokebox over the entire length of the boiler to the cab-turret casing. The sand box is made in two halves straddling the collector saddles, and the U-shaped

Table of Dimensions, Weights and Proportions of the Canadian National Sample 2-8-2 Type Locomotives

Railroad	Canadian National
Builder	Canadian National (Pt. St. Charles Shops)
Road class	S-4-a
Type of locomotive	2-8-2
Service	Freight
Cylinders, diameter and stroke	24 in. by 30 in.
Valve gear, type	Baker
Valves, piston type	14 in.
Maximum travel	8¾ in.
Outside lap, main ports	2½ in.
Outside lap, compensated ports	2⅛ in.
Outside lap, auxiliary starting port	¾ in.
Exhaust lap	1/16 in.
Lead, constant	1/16 in.
Weights in working order:	
On drivers	237,000 lb.
On front truck	39,000 lb.
On trailing truck	61,200 lb.
Total engine	337,200 lb.
Tender	272,300 lb.
Total engine and tender	609,500 lb.
Wheel bases:	
Driving	16 ft. 9 in.
Total engine	37 ft. 8 in.
Total engine and tender	76 ft. 3¾ in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	31¼ in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	12 in. by 13 in.
Driving, others	10 in. by 13 in.
Engine truck	7 in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Inverted wagon top
Steam pressure	265 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	80⅜ in.
Diameter, third course, outside	90 in.
Firebox length and width	120⅛ in. by 84¼ in.
Arch tubes, number and diameter	2—3 in. O.D.
Syphons	2
Combustion chamber	23½ in.
Tubes, number and outside diameter	42—2¼ in.
Flues, number and outside diameter	167—3½ in.
Length over sheets	17 ft. 4 in.
Grate area	70.28 sq. ft.
Heating surfaces:	
Firebox and combustion chamber	339 sq. ft.
Tubes and flues	3,065 sq. ft.
Total evaporative	3,404 sq. ft.
Superheating surface	1,591 sq. ft.
Combined evap. and superheat	4,995 sq. ft.
Tender:	
Water capacity	11,000 Imp. gal. (13,200 U. S. gal.)
Fuel capacity	20 tons
Wheels, diameter outside tires	34¼ in.
Journals, diameter and length	6 in. by 11 in.
Rated maximum tractive force	56,200 lb.
Weight proportions:	
Tractive force ÷ comb. heat. surface	11.3
Weight on drivers ÷ tractive force	4.21
Total weight engine ÷ comb. heat. surface	67.7
Boiler proportions:	
Tractive force ÷ comb. heat. surface	11.3
Tractive force × dia. drivers ÷ comb. heat. surface	710
Firebox heat. surface, per cent of evap. heat. surface	9.95
Superheat. surface per cent of evap. heat. surface	46.8
Firebox heat. surface ÷ grate area	4.83



showing dry pipe and connections

casing is fitted into it at the front and back faces, and into the cab turret casing, forming an unbroken outline from the front to the rear of the boiler.

Feedwater enters the boiler on the top center line of first course directly beneath the dry pipe. A small steel casting, with inlets at an angle of approximately 30 deg. on each side and tapped to receive 2-in. iron pipe, is riveted to the boiler. Short lengths of double-extra-heavy pipe, screwed and welded, join these inlets with cast-steel flanged elbows which extend beyond the U-shaped casing and serve to attach the right- and left-hand boiler-check valves.

Silicon steel is used throughout in the construction of the boiler shell, with the exception of the welt strap of the third course, from which the manhole is flanged and where ordinary open-hearth boiler steel is used.

Boiler Accessories

A Type E superheater with multiple throttle header is applied. The firebox, of liberal grate area, is fitted with two Nicholson Thermic syphons and two 3-in. outside diameter arch tubes and a 23½-in. combustion chamber. The somewhat limited tube length imposed restrictions at this point. The net firebox volume, after deducting the arch, syphons and arch tubes, is 361.25 cu. ft. Canadian National standard round-hole grate bars are used, which provide a free air opening of 11.8 per cent. An ashpan of moderate slope and ample capacity, fitted with Canadian National standard cast-steel hoppers and swinging doors, a type BK stoker, Franklin single-cylinder grate shaker and Franklin fire door, an Elesco feedwater heater and Superior automatic soot blowers complete the boiler and auxiliaries.

Front view of the Canadian National 2-8-2 type locomotive

Originally an Elesco centrifugal pump was fitted, but since going into service this pump has been replaced by a type CF-1 Elesco pump, which is supported on the same bracket cast on the left side of the cradle, below the ashpan, which was for the centrifugal pump. An H.N.L. injector is located on the right side.

The cut-off is limited to 64.8 per cent on the main ports, while on the auxiliary ports it is 83 per cent. An additional five per cent compensating cut-off is provided on the head end of each cylinder by a slight enlargement of three ports, still further improving the starting torque, and, with a factor of adhesion of 4.21, the locomotive showing little tendency to slip. The 14-in. piston valves are actuated by a Baker long-travel, long-lap type of valve gear.

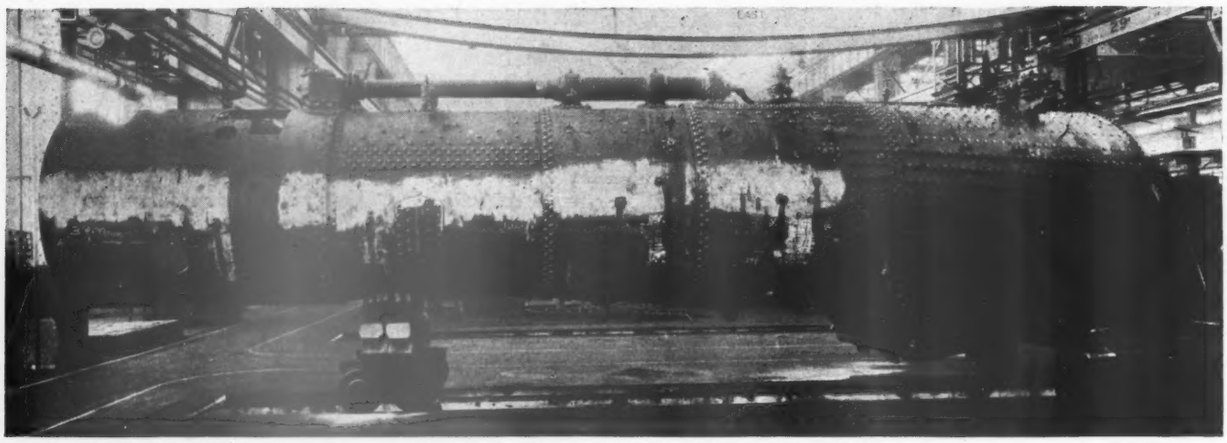
Frames and Running Gear

The main frames are nickel cast steel and the cylinders and steam pipes are nickel cast iron. The main and side rods are nickel steel. The main crank pins and axles are of Steel, Peech & Tozer quenched steel. The single guide bar is of nitrided alloy steel and forced lubrication is supplied to this detail, as well as to the valves and cylinders, by a Nathan D.V.S. lubricator on the right side.

The engine truck has outside bearings and provides 40 per cent constant resistance, while the trailing truck is the Delta outside bearing with 20 per cent constant resistance, both of General Steel Castings Corporation manufacture. The engine and trailing truck and the main driving journals are fitted with Canadian National standard revolving-bushing boxes.

Tenders of Unique Construction

The tender of this locomotive is of interest, being an improved design of the Canadian National standard frameless Vanderbilt tank, first introduced on a number of 4-8-4 locomotives built in 1929. The later design used on the No. 3800 was also applied behind 4-8-2 engines built during 1930.



Boiler of the Canadian National 2-8-2 type locomotive designed for service in bad-water territory

The Canadian National now has in service, or in the course of construction, more than 50 tenders of this same general arrangement. No underframe is employed. The bottom tank plate of 1-in. thickness forms the backbone to which the draw and center castings are riveted and welded. The internal bracing is of such a nature as to add substantially to the rigidity of the bottom structure. Tenders of this general design in service over a period of practically 2½ years have rendered satisfactory service. They have proved their ability to withstand the shock of collision and, although the body plates were ruptured, the under structure was found to be intact.

In the latter design, as used on the No. 3800, considerable lightening in weight, mainly in the castings, was effected and the compartment for housing the stoker engine was relocated. This compartment is now placed directly in the rear of the conveyor. The engine is carried on a cast-steel base plate and is connected to the conveyor gear shaft without using the customary shaft and universal joints. Only one joint is required for alinement purposes, making a more compact connection. Access is had to the compartment by means of a casing which passes out through the side of the tank and is fitted with a hinged door. The design of the vestibule diaphragm spring equipment has been modified and the diaphragm is now of all-welded plate construction. The rear bumper beam of cast steel has been eliminated and a structural steel platform of a design suitable for jacking has been substituted. The locomotive cab is also of welded construction, but of the railroad's standard design.

Rear view of the tender

Miscellaneous Equipment

A new style of coal gate has been fitted to the bunker of the No. 3800 and is giving satisfactory service. The customary construction using four or more leaves has been replaced by a single flat-hinged door. This door provides access to the coal space, and a small door of semi-cylindrical shape revolving on trunnions furnishes the necessary opening for hand-firing or adjusting stoker slides. Peep holes covered by small pivoted slides are provided so that a bar may be inserted to break down any arching of the coal before it is off the entrance gate. The front tank plate is not cut away to the same extent as before and can be substantially braced. Six-wheel General Steel Castings Corporation trucks with clasp brakes are applied.

One 8½-in. Westinghouse cross-compound air compressor is applied at the front end on the left side of the locomotive and is supported on a cast-steel bracket, carried from the frame and engine truck center-pin guide. A plate shield is fitted in front, as shown in one of the illustrations. The pump throttle is located on the auxiliary steam-pipe elbow at the left side of the smokebox. It uses superheated steam and is opened and closed by enginehouse forces. The whistle is attached at the same point and is operated by a cable through the left handrail.

The tender brake equipment is somewhat modified, an 18-in. brake cylinder with Type L triple and double chock valve being employed. The by-pass feature is inoperative and the triple functions in lieu of a brake-pipe vent valve. This arrangement is standard on most of the Canadian National heavy power.

Precision power reverse gear, Franklin safety bar and side-spring radial buffer of a special design to suit Canadian National clearance requirements are applied. An Elesco trap is fitted in the tender tank, the condensate and stoker exhaust being piped into it. Practically all iron piping on the engine and tender is welded, thus eliminating as many sources of leakage as possible.

EDITORIALS

Mechanical Department As a Traffic Builder

The motor bus and the private automobile have both cut heavily into the railroad passenger traffic and apparently much of this business has been lost permanently. On the other hand, there seems to be little doubt but what the railroads can regain some of this traffic, if they go about it in the right way; and, incidentally, there are possibilities that the mechanical department can render substantial aid in so doing.

Many people, after the novelty has worn off, find a growing dislike to driving long distances in their automobiles, and few people will confess to a liking for long distance traveling on a motor bus. They travel thus because it is cheaper or the schedules are more convenient. The smoother riding of the train makes it possible to read and do a certain amount of work with a reasonable degree of convenience, and many people prefer to use the train if their schedules meet their peculiar needs. Such people, however, complain of the dust and cinders, to the excessive noise on the train, and to the condition of the toilets on coaches. These, however, should not be insurmountable obstacles. Cannot the mechanical department find ways and means of overcoming them? The results would undoubtedly be clearly reflected in the larger number of people who would insist on traveling by rail, and this will be particularly true if ways and means can be found, at the same time, of speeding up the trains.

Study The Wheel Job

One of the most expensive items in connection with equipment repairs is the maintenance of wheels, by far the biggest volume of this work being devoted to the inspection, dismounting, scrapping or re-turning and re-applying of car wheels. The Wheel and Axle Manual, adopted as recommended practice by the Mechanical Division in 1928, presented for the first time in compact form reliable information regarding the proper handling of car wheels and axles. It has unquestionably been responsible for a marked improvement in wheel and axle practice, railroads generally benefitting in proportion to the thoroughness with which inspection forces and wheel-shop men have familiarized themselves with the contents of the book.

The Wheel and Axle Manual comprises the recommended practice of the Division with regard to specifications and design, manufacture, handling, storage and shipment of wheels and axles. There can be no question as to the desirability of the majority of these practices and, when not installed, the indication is plain that wheel-shop forces have not been adequately instructed. With respect to certain practices, such, for example, as the building-up of worn journal collars, some difference of opinion still exists. The manual recommends the reforging of axles as a better practice than building-up end collars by welding, because reworking of the material has a tendency to improve the grain structure. The welding of collars is now permissible under American Railway Association rules, but, pursuant to the action of the Mechanical Division at the 1931 meeting, a letter ballot will be sent out in the near future on the desirability of eliminating all welding in connection with car axles. While the proper annealing of axles subsequent to the welding operation relieves expansion and contraction stresses, the fact remains that if welding is permitted on one part of an axle, it may be extended to unauthorized places with resultant accidents such as have frequently occurred during the past few months.

Wheel mounting is another subject of great importance in which the Wheel and Axle Manual should be followed closely. A great improvement has been effected in this particular since the introduction of the manual, but some shops are still not provided with standard mounting gages. From the point of view of production cost as well as safety, wheel shop practices may well be examined into with the greatest care. One wheel shop machines a new axle complete from the rough-turned size in an average time for all classes of 60 min. per axle. If all shops on the system are not doing as well as this, steps should be taken to determine the reason, whether chargeable to man-failure, inadequate lathe equipment, poor cutting tools, or a lack of effective axle-handling equipment. One shop machines second-hand axles complete in 40 min. each; trues up lathe centers in axles, including necessary reaming, in 10 min. each; bores cast-iron wheels, including set-up and handling, in 8 min. per wheel; bores steel wheels to fit the axle, including setup and handling, in 20 min., and mounts cast-iron or steel wheels, complete, in 16 min. How does this time compare with the performance in your shop?

The Mechanical Department's Contribution

Some idea of the magnitude of steam-railroad operations in the United States can be gained from the fact that, in spite of handling less than the usual amount of business, Class I carriers burned over six million tons of coal and 165 million gallons of fuel oil in locomotives in June, 1931. This fuel cost almost 17 million dollars, as compared to about 21 million dollars spent by Class I carriers for locomotive fuel in June a year ago.

Of the many ways in which mechanical departments can contribute to operating efficiency and help the railroads meet the emergency created by present conditions, probably none is more important than the economical use of locomotive fuel. Next to labor (and, in recent years, taxes), fuel constitutes the largest single item of operating expense and one directly influenced by the work of the mechanical department. Not only does the mechanical conditions of cars and locomotives have an important bearing on the efficiency with which locomotive fuel is used, but refinements in design and improvements in locomotive details may well be carried to completion during the present period in order that railroads may capitalize to the greatest possible extent on reduced unit locomotive fuel consumption.

Commendable efforts along this line have been made by a number of roads, such, for example, as the Illinois Central, in developing the Mays front-end arrangement, which is named in honor of the present general superintendent of motive power, and has already accomplished marked results in fuel economy. Experiments with locomotive front-end designs have been going on for many years with a varying degree of success and it might be supposed that further improvements could hardly be anticipated. Apparently, such is not the case since the new front-end arrangement, embodying a combination of the "Goodfellow" exhaust tip and the basket bridge, is credited with an actual average fuel saving of 12.5 per cent in fuel consumption, as compared with the old-style front-end arrangement. The details of this test, which will be published in a subsequent issue of the *Railway Mechanical Engineer*, indicate that the use of the Mays front-end permitted increasing the nozzle diameter of a Mountain-type locomotive, for example, from 6⅜ in. to 7⅜ in., resulting in a reduction of back pressure to a maximum of 3½ lb., with attendant increases in available tractive force reduced water consumption and lessened maintenance on account of smaller back-pressure stresses.

Almost a thousand locomotives on the Illinois Central have already been equipped with the Mays front-end arrangement, which not only promotes fuel economy on individual locomotives, but also permits Pacific-type locomotives of 40,758 lb. tractive force, for example, to be used in place of Mountain-type locomotive of 51,121 lb. tractive force, hauling heavy passenger trains on fast schedules. The overall economies are such that the fuel consumption per 100 passenger-car miles is reduced as much as 25 per cent. With an average cost per locomotive for the installation of the new type of front-end of $25 each, the outstanding improvement in locomotive performance and reduction in operating expenses is paying a handsome return on the cost of developing the equipment.

Interchange Rules and Car Inspectors

On The Reader's Page of this issue is a letter by T. J. Lewis which is one of a series of exchanges following the publication of the abstract of H. R. Rice's address before the Indianapolis Interchange Car Inspectors Association which appeared in the Feburary issue of the *Railway Mechanical Engineer*. Mr. Lewis, himself an inspector, has ably presented the inspectors' viewpoint with respect to Mr. Rice's contention that much of the discussion of the application of the rules of interchange at meetings attended by inspectors pertains to "trick questions".

The opposing viewpoints held by these two men are probably typical of those held by large opposing groups of men, even in the car department, and certainly by large opposing groups in the transportation and operating departments and the car department.

While nothing that may be said in these columns is likely to compose these opposing viewpoints as to what are useless technicalities and what are points for constructive consideration, it may be worth while to point out why technicalities or even "trick questions" would probably continue to arise as long as a code of interchange rules is involved in railroad operation. The reason lies not in the mental peculiarities of the men whose responsibility it is to apply these rules at the hundreds of interchange points throughout the country, not does it lie in the character of the rules as they have been developed up to the present time. It is inherent in the very nature of any set of rules developed to control the actions of men in situations where opposing interests are involved.

The intent of the rules of interchange is set forth in three sentences in the preface. If all men agreed as to what is a "fair and proper adjustment" in specific instances as readily as they agree to the fairness and soundness of these three basic purposes of the rules the preface might well constitute the entire code. But, because men with the same standards of fair dealing cannot agree as to what is fair and proper in the innumerable varieties of specific cases more than two hundred pages of rules are required to interpret the meaning of three simple sentences, and nearly 1,700 decisions in arbitration cases have been required to interpret the meaning of the rules.

A rule is of little value unless it is specific. Unfortunately, the more specific the rule, the less ground it can cover. Hence the difficulty in making its application clearly apparent to the many combinations of circumstances which, as our correspondent says, are as numerous as the potential combinations of a Yale lock.

It is unfortunate, but none the less generally true, that in making rules so specific that they may be applied with a reasonable degree of uniformity by different men —which is the test of their practical value—they must in some measure compromise the principles which they are designed to carry into effect. Rule 32 is probably as good an illustration of this point as any. It does not necessarily imply a lack of sincerity on the part of those responsible for bringing up the many cases involving this rule, which are settled against them because, technically, none of the conditions specifically set forth in the rule applies. Many of these lost cases are within the spirit of the rules, but to make exceptions in deciding such cases would soon destroy the rule. Once established, the letter of the rule of necessity becomes more important than the principle.

Rules being what they are, interchange inspectors, if they do their jobs correctly, must of necessity be technical. If the rules are to continue effective, these men cannot substitute their own judgment in any situation for the intent of the rule, as the words in which it is framed, convey that intent to them. There is but one alternative for technicalities and "trick questions" in dealing with the interchange of cars between railroads; that is, no rules at all.

Whether it is better to place the entire burden of the cost of maintenance in interchange, say, on the car owner, or to continue the present code of rules with its burden of technicalities and delays, not to mention dollar swapping accounting, is purely a matter of expediency. There are responsible car men who believe that something like the former course is the most desirable and there are many who are in favor of a middle ground course in which the number of billable defects would be materially reduced. Either course would undoubtedly increase the amount of unfairness in specific cases, but those favoring either of these proposals believe that in the aggregate no essential unfairness or essential change in net debit and credit balances in expenditures for interchange maintenance would result.

The practicability of some such modifications of the rules will probably be the subject of study by the Arbitration Committee during the coming year. In the meantime the railroads will have to accept technicalities

and give serious attention to the discussion of trick questions, so-called, as the price of maintaining a set of interchange rules. The tricks are in the rules, not in the questions.

Fabricating Aluminum Car Parts

The demand for greater economy in railway operation has led to an increasing urge in recent years for lighter equipment or, in other words, cars which will handle the same number of passengers or the same number or tons of freight without the expense involved in moving excessive amounts of tare weight. The result of this demand has been the study of lightweight designs and the use of lighter materials, one of the most important of the latter being the strong alloys of aluminum.

An examination of the records shows that aluminum was first applied extensively in steam-railroad service in composite, steel-aluminum, multiple-unit suburban cars on the Illinois Central in 1923. In 1926, the Pennsylvania went a step further by constructing multiple-unit cars with all parts above the underframes made of aluminum. For the past year and a half, the larger commercial shapes and plates of aluminum have been available in sufficient lengths for the longest cars, and multiple-unit electric railway cars are now in service in which practically the entire car bodies, including the underframes and superstructures, are made of aluminum.

In general, strong-aluminum alloys of the duralumin type are used for the stress members and girder sheets, unheat-treated aluminum alloys being specified for the interior finish, conduit, fittings, etc. Experience with these cars apparently indicates that aluminum construction is well adapted to stand the hard usage encountered in both electric and steam railway service and it seems certain that within the next few years railway car-department supervisors and repair forces generally will be required to deal with a considerable amount of equipment built largely of aluminum.

A study of the construction of all-aluminum cars shows no great departure from the general practices involved in building and repairing steel cars. The two most striking characteristics of aluminum include light weight—which is very apparent and an important advantage in shop handling—and high heat conductivity, which rapidly dissipates heat applied in welding or through the application of hot steel rivets. Welding operations, when necessary, can be carried on by experienced operators on aluminum without unusual precautions, but the strong-aluminum alloys cannot, of course, be welded without losing their physical properties acquired by heat treatment.

Strong-aluminum plates and shapes can be worked to a certain extent cold. They can also be worked to a limited extent hot, providing the temperature is not permitted to exceed 300 to 400 deg. F., which must be accurately determined by a pyrometer or other means, as aluminum has a relatively narrow critical range and heating much above the temperature mentioned will result in a loss of physical properties due to heat treatment.

It is interesting to note, in connection with one lot of all-aluminum multiple-unit cars now in service, that the center sill is made of a strong-aluminum plate pressed cold, the side sills of rolled strong-aluminum angles, the body bolsters and cross bearers built up of diaphragms pressed cold, side and end posts of box-section aluminum pressings, carlines of pressed aluminum, and girder sheets, letterboard, inside finish, headlining and other details of aluminum sheets. In constructing the pilots made of aluminum angles and tubing, several sharp bends were required which could not be made cold successfully and required local heating, not to exceed 400 deg. F., to avoid fracture of the material. With suitable precautions against overheating, however, this bending, which involved practically a forging operation, was successfully carried out on the strong-aluminum angles and tubing used in the pilots. All pressings were made in a hydraulic press of the proper capacity, using dies similar to those employed in manufacturing steel car parts, and about the only precaution observed was to follow the recommended general practice of making the radius of curves at least four times the thickness of the material.

In view of the noticeable trend toward lighter railroad equipment and the probable greatly increased use of aluminum alloys in car construction within the next few years, railway car-department officers and supervisors will not overlook the opportunity to acquaint themselves in advance with the characteristics and advantages of this relatively new material as well as the best methods of working it.

NEW BOOKS

METAL STATISTICS. *1931. Published by the American Metal Market, 111 John street, New York. 4 in. by 6 in., 552 pages. Price $2.*

This, the twenty-fourth annual edition of Metal Statistics, contains the same general assortment of statistical information concerning ferrous and non-ferrous metals that has been supplied in previous years, but various new tables have been introduced and the economic data increased. Data on population, income, wealth, car loadings, etc., have been included, also data on the production of steel ingots and castings as far back as these statistics are available, and steel industry operating rates and fabricated structural steel shipments. In non-ferrous metals further additions have also been made covering production, stocks, prices, etc.

TREATISE ON LEATHER BELTING. *By George B. Haven, S. B., professor of advanced machine design in charge of textile research, and George W. Sweet, S. B., professor of machine design, both of the Massachusetts Institute of Technology. Bound in cloth, 5½ in. by 8 in., 249 pages. Published by the American Leather Belting Association, New York. Price $1.50.*

The book takes the reader from the first stage in leather manufacture through all stages of the work required to transform the raw hide into finished belting leather and describes the different kinds of leather and their proper field of use. It also presents in detail the various grades and weights of belting available; the right pulley to use and why; practical rules governing the application of belts to machines; tables of horsepower developed at different belt speeds; proper use of idlers; short center drives; hinged motors for short center drives, and other features of belt drives.

A chapter is devoted to the care of leather belting and another on motor drives; relative value of group and individual drives; table of costs, etc.

THE READER'S PAGE

Why Two Oils—Summer and Winter?

To the Editor:

It is my opinion that there is no good reason for the use of two oils. During the warm weather very little trouble is experienced with hot boxes due to lubricating conditions, but it is when cold weather sets in that hot boxes appear due to improper lubrication. This is on account of congealed oil which prevents the free flow of oil to the bearing especially on cars that have stood around yards, where the journals are cold, and are then placed in trains. Congealed oil is also responsible for the rolling of packing. Some oils do this more than others. When the packing is rolled away from the journal at the time a train is started from the terminal, hot boxes are bound to develop.

One way to overcome hot boxes to a considerable extent would be to gage the oils by the cold weather performance, as that is when we are having trouble. At present, too much heavy or summer oil is used on account of the larger number of cars being repacked in warm weather, thus creating hot-box trouble for cold weather.

After a car has been repacked and heavy summer oil is used, the first thing that happens when entering cold weather is the rolling of the packing away from the journal. The only remedy is the use of a cut-back oil or a light grade of oil to break up the congealed oil, permitting it to flow to the bearing and allowing the packing to stay in its proper place. In applying this remedy, it often becomes the practice to overdo the application of the light oil. This results in too light an oil for summer use as the oil will lay at the bottom of the box and cease to lubricate.

In arriving at a one-season oil, an oil should be used that will not become too heavy or sticky in cold weather and that will flow from an oiler without the application of heat. This will eliminate the use of light oil as a thinner.

Another feature that is sadly neglected and which has a great deal to do with the congealing of oil in journal boxes is the proper maintenance of the dust guard and application of covers that will exclude the greatest amount of dust. The journal-box face should be finished so as to permit the cover to fit closely.

To prevent the rolling of packing in journal boxes is the one big thing to prevent hot boxes.

T. P. Schmidt.

The Big Car Shop

To the Editor:

Mr. Richmond's article on whether or not the big car shop is justified brings out many interesting points on the car maintenance problem and matters that require deep study. Personally I am in favor of the concentration of car work and believe the past practice of attempting to do a lot of big things in a lot of little places seriously affects the cost of car maintenance. Many roads formerly repaired cars (and some still do) as they failed or became wholly unfit for any service, instead of anticipating and arranging for repairs to cars by series after specified number of years of service, preventing in this way consequential damage due to weakened parts, deterioration from corrosion and providing the traffic department with better cars.

In addition to this saving, the costs of repairs are materially reduced by the systematic repairing of cars by series, and the reduction of store stock carried over a long period to protect cars that become unfit for service intermittently results in a real saving and reduces obsolescence of material.

I believe the term "major shop" is more appropriate for most railroads and were I asked for my views on this matter, I would recommend major shops geographically located to care for cars as they come to the point where the loading originates which prompted the management to purchase equipment of the type in question.

On the Illinois Central, as an example, we now have three car shops that could be termed major shops. One located at McComb, Miss., where all refrigerator cars are given classified repairs. This shop is close to the originating point of our bananas and in the valley that grows fruit and vegetables in large quantities. At Nonconnah, near Memphis, Tenn., we have a major shop where all house and flat cars are repaired. This shop is in the center of northern and southern lines and cars leaving this shop receive such loads as coffee, sugar, grain, cotton-seed products, lumber, logs, piling, etc. At Centralia Ill., we maintain a major shop for the repairing of coal cars. This shop is located in the center of the Southern Illinois coal fields and in line with the movement of empty coal cars from the north to the Kentucky coal field.

The above reference to the cars repaired at these shops takes into account classified repairs, as emergency repairs are made to all types of cars at these shops. Formerly this classified work was spread over 14 to 16 points.

Mr. Richmond's criticism of the big shop is not justified in its entirety as it has many good points. Among the most important are the housing of cars and men, eliminating the application of rust preventatives and paint to surfaces at low temperatures or wet from rain or humidity, permitting men to dress so they can work efficiently, and the handling of heavy parts by cranes and modern appliances.

Light repairs can be made in a big shop at times when no classified repairs are available or the condition of the traffic does not warrant such repairs, and at a saving. The big shop cannot be condemned for this reason as one railroad has gone into this feature and proved to its own satisfaction that in a modern shop light repairs can be handled more efficiently and at a real saving to the railroad.

Mr. Richmond's article touches on the classification of repairs showing how the Interstate Commerce Commerce Commission classified repairs and an example of how some roads have set up a yard stick of man-hours for classification purposes. The Illinois Central is the only railroad I know of which has set up a definite workable system of knowing exactly what their classified repairs are costing and are classifying their repaired cars accordingly

The words "estimated cost" have been eliminated from our vocabulary as far as the cost of classified car

repairs are concerned on this road. Man-hours may be of some help but in no way reflect the cost and as far as estimates are concerned they are guesses by car foremen and others and, as no one has any real data to check them, their guess or estimate is accepted as the best solution of the problem.

On the Illinois Central, after several cars of a certain series are repaired we know exactly what the labor and material costs are and have no trouble in arriving at the cost to repair cars in the same series. This plan has been of great assistance to our general officers in arproperly arriving at the cost of repairs to cars set aside.

W. J. McCloskey.

One Car Oil For All-Year Performance

To the Editor:

In the letter entitled "Limited Use of Free Oil Defended," which appeared on The Reader's Page of the June, 1931, issue, "Car Department Officer" raises the question "Since boxes are repacked only once a year, why two oils—summer and winter?" Having spent six years in intensive work connected with this same question, perhaps I can inject some interesting high lights into the discussion.

Traditional practice has carried on since the beginning, but is due for a change. A summer journal oil having a body weight from 65 to 75 sec. at 210 deg. F., with an average cold test of 15 deg. F., is the primary cause of waste grabs and congealed packing at temperatures below 30 deg. F. We know that 70 per cent of box failures occur during zero and sub-zero temperatures. As a concrete example, flushing oil for crank cases of automobiles has a weight of 38 sec. at 210 deg. F., but at zero this body weight increased to 10,000 sec This will give you a slight idea of what occurs at cold temperatures.

Major railroad officers are coming to the point of accepting an all-year car oil. The most suitable product produced so far is a winter oil with a body weight of 50 sec. at 210 deg. F., or one with a film strength sufficient to keep the metallic surfaces separated on new installations, such as new wheels, new or broached brasses, etc. We have found that an oil of this type will carry the new installation and, with a cold test of between minus 30 and minus 40, this oil does not congeal and cause waste grabs, with resultant box failures when used for the entire year.

We have found when we run into the extreme minus temperatures ranging from zero to 50 deg. F. below that then it is necessary to use a cut-back or thinning oil which has a cold test ranging from minus 50 to minus 75. This product, when applied to the front of the journal and around the collar, washes the heavier oil back toward the fillet and it then settles in the cellar of the box, leaving the light oil on top of the waste and, in turn, it is wiped onto the journal. This is a much better practice than using engine wiping oil, kerosene and distillate, as has been the practice on some of the roads operating in the colder ranges for some time past.

If you will look over the car-mileage records for hot-box failures, you will note that the mileages are increasing between failures each year. The writer knows personally where this practice has more than doubled and trebled the performance on several major lines, and it is an ordinary circumstance today to see such records as 200,000 to 500,000 box-car miles per hot box.

We believe the time is fast approaching when one oil only will be used for all-year performance and, when necessary, a cold-weather car oil, or cut-back oil, will be used as a supplement during the sub-zero ranges of temperature.

An Oil Man.

But Are They Trick Questions?

To the Editor:

In his letter on page 372 of the July issue of the *Railway Mechanical Engineer*, H. H. Rice takes exception to my reference to the study of Latin by way of illustrating a point. The study of Latin referred to by him as having been dropped as a mandatory study from the high school curriculum Tee's off with the vacant rules in the A.R.A. code, also mentioned by him, instead of with the discussions in the car foremen's meetings. Live discussions do not come out of dead issues, Old Man Sampson's yarn about the honey bees in the lion's skull, notwithstanding.

Mr. Rice's arithmetic is correct, but his assumption that twenty questions can be discussed and disposed of at any one meeting of reasonable duration is far from the real facts. He says further, "And as the majority of questions cover only a few of the rules it can readily be seen that the field for legitimate questions is rapidly covered." No rule is ever covered by any question, or any number of questions. Just when you think you know the last thing about the application of a rule to interchange work, up will bob a case just like a hundred you've handled before—only different; and you can't find a parallel to it in all the 1664 cases that have already been handled by the Arbitration Committee. Many of the rules are as full of potential combinations as a Yale lock when it comes to applying them in actual practice.

Where there are as many as twenty inspectors, each on a live interchange job, there will be no lack of "legitimate" questions for discussion, if they are not too backward about relating their experiences. Most car inspectors are not given to doing much talking in a meeting and require much drawing out to get them to say anything at all. If, as is often the case, there is not a skillful leader to direct the discussions, the meeting is apt to fall flat or drift into channels not suited to the occasion. This is unfortunate for the men and more so for the railroads for which they work, because their interest in their work is slackened by the failure of the meeting to produce the results desired. Men do not attend these meetings for fun, nor for the purpose of learning new tricks by which to delay traffic. Their attendance is evidence of an earnest and very commendable effort to learn to do their work better. What they need is real help and direction, instead of a lot of adverse criticism.

Mr. Rice's letter implies a lack of confidence in the sincerity of the car department officers who submit their disagreements to the Arbitration Committee for decision—that they are fellows of loose morals who know they are wrong to begin with, but since they have no confidence in the integrity of the members of the committee, they think perhaps they will be able to "put one over" and filch something from another company for their own. If that be true, verily they should all quit their useless jobs and assist the traffic department.

T. J. Lewis.

With the Car Foremen and Inspectors

Checking Braking Force on Cars

FREQUENTLY rip-track foremen and car inspectors are required to check the braking force of cars not equipped with badge plates or for which blue prints showing the correct lever dimensions are not provided. The following instructions have been issued by the air-brake supervisor of an eastern road to facilitate the checking of such cars:

Brake-cylinder values for various pressures are shown in the table. Assuming a brake-cylinder value of 3,925 lb. and a braking force of 7,200 lb. per beam or 3,600 lb. per shoe with truck levers 6 in. and 18 in. as shown in the diagram; then 7,200 multiplied by 4, or 3,600 multiplied by 8, equals 28,800 lb. total brake-shoe pressure. Divide 28,800 by 48,000 and the result is 60 per cent.

Taking the problem another way. If it is known that the light weight of a car is 48,000 lb., then 60 per cent of 48,000 is 28,800 lb.

One of the primary features to bear in mind when computing the result of applying a force at one end of a lever and getting something else at the other end is that the force applied multiplied by the distance from the point the force is applied to the fulcrum, divided by the distance from the fulcrum to the point the force is delivered, gives the force delivered. Taking the total cylinder value of

$$\frac{10.375 \times 3{,}925 \text{ lb.}}{22.625} = 1{,}800 \text{ lb.}$$

The second step will be to multiply the force on the pull rod by the distance from the point the force is applied to the fulcrum of the truck lever which, in this case, is 24 in. This is divided by 6:

$$\frac{1{,}800 \times 24}{6} = 7{,}200 \text{ lb.}$$

If it is desired to know the force exerted on the truck-lever connecting rod; the force on the pull rod multiplied by 18 divided by 6 equals 5,400. This figure, 5,400 lb. multiplied by the distance from the point the force is applied to the fulcrum (24 in.) divided by the distance from the fulcrum to the point the force is delivered (18 in.);

$$\frac{5{,}400 \times 24}{18} = 7{,}200.$$

To know what brake-shoe pressure is delivered on the end equipped with floating lever, it is necessary to determine the force exerted on the brake cylinder connecting rod. If the brake-cylinder value is 3,925 lb. and the force on pull rod is 1,800 lb., the sum of these two forces will be the pull or force exerted on the brake-cylinder connecting rod, 5,725 lb. Multiply the cylinder value of 3,925 by the total length of the cylinder lever (distance from the point the force is applied to the fulcrum) and divide by the distance from the fulcrum to the point the force is delivered:

$$\frac{3{,}925 \times 33}{22.625} = 5{,}725$$

Also 1,800 lb. multiplied by 33 (distance from the point the force is applied to the fulcrum) divided by the distance from the fulcrum to the point the force is delivered, is

$$\frac{1{,}800 \text{ lb.} \times 33}{10\frac{3}{8}} = 5{,}725$$

Knowing that the force of the brake-cylinder connecting rod is 5,725 lb., the force delivered to the pull rod will be 5,725 times the distance from the point the force is delivered (27 in.)

$$\frac{5{,}725 \times 8\frac{1}{2}}{27} = 1{,}800 \text{ lb.}$$

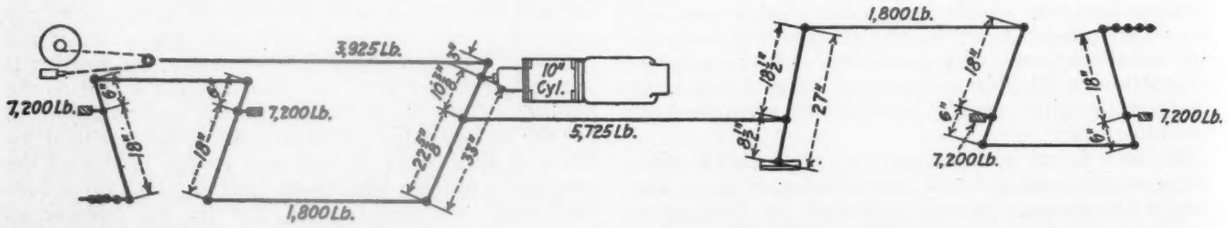
The method of determining the force delivered at the brake shoe is the same, as explained, for the other truck. This is a practical means of determining the total brake-shoe pressure and the relation of the total brake-shoe pressure to the light weight of the car. This is known as braking ratio.

Brake-Cylinder Values for Different Pressures

Diameter, in.	Area, sq. in.	Force: 50 lb. per sq. in.	60 lb. per sq. in.	85 lb. per sq. in.	100 lb. per sq. in.
6	28.3	1,400	1,700	2,400	2,830
8	50.1	2,500	3,000	4,250	5,010
10	78.5	3,950	4,700	6,700	7,850
12	113.1	5,650	6,800	9,600	11,300
14	154.0	7,700	9,250	13,100	15,400
16	201.0	10,050	12,050	17,100	20,100
18	254.0	12,700	15,250	21,600	25,400
2— 8	100.5	5,050	6,050	8,500	10,050
2—10	157.1	7,850	9,400	13,400	15,710
2—12	226.0	11,300	13,600	19,200	22,600
2—14	308.0	15,400	18,500	26,200	30,800
2—16	402.0	20,100	24,100	34,200	40,200
2—18	508.0	25,400	30,500	43,200	50,300

In checking the braking force it may be found to be more or less than it should be, in which case it will be necessary to properly locate the fulcrum points in both the cylinder and floating levers

The following is the proper procedure:



Sketch of brake-rigging diagram for use in checking the braking force on cars not equipped with badge plates

1—Locating the fulcrum points on the cylinder lever when an 1,800-lb. pull is necessary on the pull rod. The brake-cylinder value (3,925 lb.) times the total length of the cylinder lever (33) divided by the sum of the brake cylinder value (3,925 lb. and 1,800 lb.) is

$$\frac{3{,}925 \times 33}{3{,}925 + 1{,}800} = 22.625$$

This is the B end—33 minus 22.625 equals 10.375 in.—this is the A end of the cylinder lever.

The next step necessary is to properly locate the fulcrum point on the floating lever. Knowing that the force on the pull rod is 1,800 lb., the total length of the floating lever is 27 in. and the force on the cylinder lever connecting rod is 5,725 lb., multiply 1,800 lb. by the total length of the floating lever and divide by 5,725 lb., is

$$\frac{1{,}800 \times 27}{5{,}725} = 8.5$$

This is the length of the short end of the lever which must be connected to the fulcrum point. Twenty-seven minus 8.5 equals 18.5, the distance from the fulcrum to the pull-rod connection or the point at which the force is delivered.

Before it will be possible to properly locate the fulcrum point on the floating lever it will be necessary to determine what force will be required on the pull rod to develop 7,200 lb. per beam or 3,600 per brake shoe. If the truck lever is 18 in. and 6 in. the sum of 18 and 6 is 24

$$\frac{24}{6} = 4; \text{ and } \frac{7{,}200}{4} = 1{,}800$$

Stenciling Freight Cars

THE illustration shows the type of stencil used in applying road initials, car number, capacity, load limit, weight figures, etc., to freight cars overhauled and repainted at the Milwaukee (Wis.) shops of the Chicago, Milwaukee, St. Paul & Pacific. A one-piece stencil, made of Monel metal with 14-gage round wire binders and mounted in a light frame, is used. On cars of the type illustrated, two of these large stencils are all that are required for application of most of the lettering.

In use, the stencil frame is pegged to the side of the car in the correct location and small one-pint cup spray guns, with gravity feed, used to apply the paint. Owing to the use of the wire binders which do not bear against the side of the car, a slight tilting of the spray gun, each way, permits paint to be applied directly under the wire binders, and full, uniform letters and figures result. When not in use, all stencils are carefully stored in a rack at the side of the shop where they are always available. The use of thin Monel metal sheets has proved economical, owing to the greatly-increased durability of the stencils and the fact that they can be cleaned readily, facilitating neat workmanship and reducing the expense.

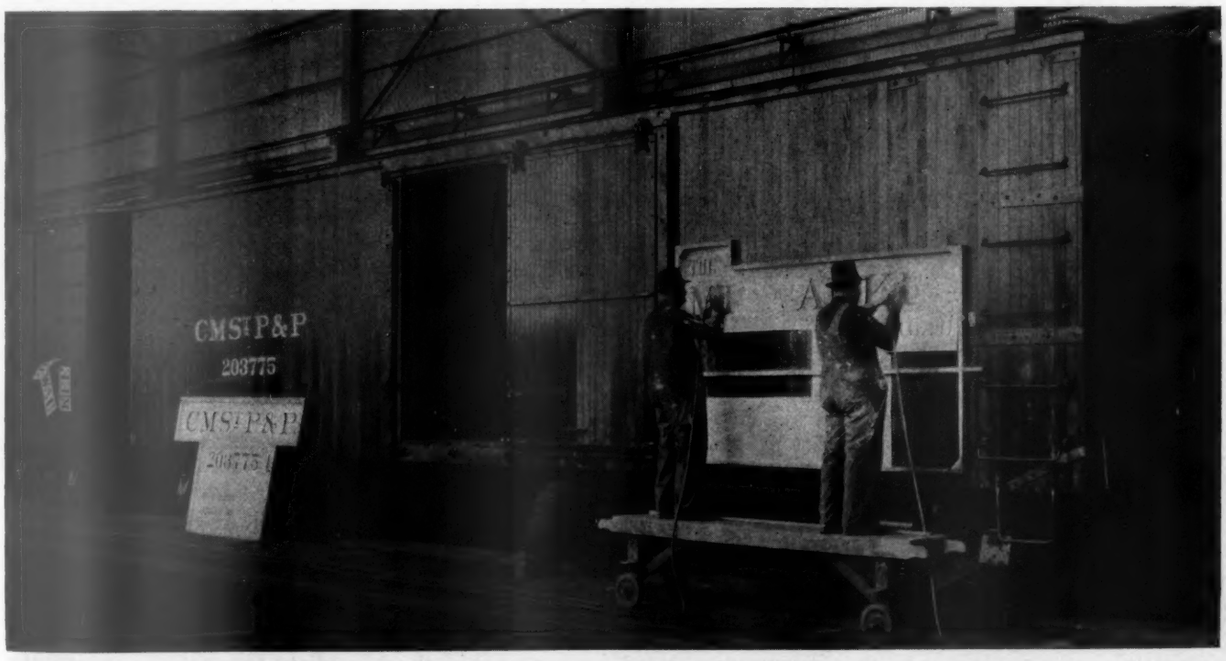
The illustration also shows a convenient four-wheeled platform used by the painters in applying stencil letters, the construction being plainly shown. The light weight of this platform, together with the wheel design, makes it readily portable and convenient in use. At the same time, the well-braced steel leg construction provides a rigid platform upon which the painters can work with every assurance of safety and with maximum convenience.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Express Charges on Coupler and Yoke Paid by Handling Line

American Railway Express car No. 793 was found at Chicago on the line of the Chicago, Milwaukee, St. Paul & Pacific on February 2, 1929, with a coupler, cast-steel yoke, and vertical key missing from the B end of the car. The C. M. St. P. & P. was unable to locate the missing equipment and ordered a coupler and yoke from the car owner. These were shipped by express, the charges for which amounted to $3.65. The American Railway Express Company contended that under Rule 95 the missing material was to be considered as undamaged and, therefore, it refused to pay the express charges. The railroad contended that the defective condition of the car was owner's responsibility and, as it had charged for the labor of making the repairs, it was therefore correct also to include the ex-



Monel metal stencils and convenient painter's platform used at the new freight-car shops of the C., M., St. P. & P. at Milwaukee, Wis.

press charges in the bill against the car owner. The express company pointed out in its statement that it shipped two couplers from its storeroom at Chicago, but not having a yoke standard to the car, an order was placed with the Union Pacific for a yoke to be shipped from Omaha, Neb., as the car was built to Union Pacific specifications. The railroad furnished two defect cards at the request of the express company. One card was used as authority for billing the railroad for the two couplers and the other card was sent to the Union Pacific as its authority for rendering a bill for the yoke furnished. The C. M. St. P. & P. billed for both labor and material, later issuing counterbilling authority for the value of the coupler and yoke which were applied to the B end of the car. It subsequently billed the Railway Express Agency for the express charges. Payment was declined as the express company contended that only labor could be charged for replacing couplers and yokes lost on the repairing line inasmuch as Rule 95 makes the delivery line responsible. The car owner contended that the repairing line should be responsible for any expense involved in procuring this material and that it believed the express charges should be considered as part of the cost of the material.

In its decision the Arbitration Committee stated: "The contention of the Railway Express Agency is sustained."—*Case No. 1670, Chicago, Milwaukee, St. Paul & Pacific vs. Railway Express Agency.*

Car Damaged by Coupling Up When Switching—Subject to Rule 44

Menasha Woodenware Corporation received an inspection report of defects on its wood-underframe box car No. 50, dated May 17, 1930, under Rule 120. The repairs amounted to a labor charge of $286.10 and a material charge of $472.92, a total of $759.02. The car owner refused to consider the damage, which consisted primarily of a broken end and side sills, sheathing and roofing, as owner's responsibility. According to the statement of the Chicago, Milwaukee, St. Paul & Pacific, the car was standing with three other cars behind it, all coupled. A locomotive with about 20 cars backed in and coupled to the four cars, of which M. W. W. car No. 50 was the first. The locomotive with the 24 cars then backed further along the same track and coupled to three other cars. The locomotive and the 27 cars were backed still further along the track and coupled to eight or nine additional cars. After this last coupling was made the bad-order condition of M. W. W. car No. 50 was noticed when a coupler on the car dropped down. All the cars which had been standing on the track in question were loaded, with the exception of M. W. W. car No. 50. The car owner contended that the car evidently failed when the first coupling was made, because it was the first car struck and that it was handling-line responsibility according to Rule 32 conditions. The railroad stated that its investigation failed to support such contention and that there was no derailment or other condition which involved Rule 32. It pointed out in its statement that the handling line obviously did not inspect the car after each coupling and is assuming that the damage did not occur until the last coupling was made, when the defects were first noticed. The Menasha Woodenware Corporation is not a subscriber to the A. R. A. Rules, but agreed to abide by the decision of the Arbitration Committee.

The Arbitration Committee decided that: "The damage to this car, occurring under the circumstances stated by the Chicago, Milwaukee, St. Paul & Pacific, does not constitute unfair usage under any of the provisions of Rule 32. The contention expressed in the statement of the car owner as to the circumstances under which damage occurred, being unsupported by any evidence, is inconclusive. Car owner is responsible."—*Case No. 1671, Chicago, Milwaukee, St. Paul & Pacific vs. Menasha Woodenware Corporation.*

Rules in Effect on Date Repairs Are Completed Govern Prices

Chicago, Rock Island & Pacific car No. 185473 was repaired by the Chicago & Alton on January 4, 1930, at Slater, Mo., and a billing repair card was attached to the latter's bill to the car owner. This stated that the car was derailed on the Chicago & Alton at Mt. Leonard, Mo., on December 23, 1929, and that the responsibility for the expense of the repairs was divided between the car owner and the handling line. Charges were made for the renewal of one cast-steel Andrews truck side, four journal-box bolts, eight tie-bar rivets, eight spring-plank rivets, and eight truck-channel rivets. The handling line claimed that the failure of the truck side was the cause of the derailment. The car owner contended that the A. R. A. rules in effect on the date the repairs were completed governed and that the C. & A. was responsible for the expense of all the repairs listed. The Rock Island in its statement referred to page 2 of the Arbitration Committee Circular No. 3—1915-1916, in which it was stated: "Each successive Arbitration Committee has held that no hypothetical cases will be considered and that all cases will be arbitrated under the rules in force at the date of the card." It contended that its position was supported by Arbitration Decisions 615 and 716, and stated that it did not believe that the prices in A. R. A. Rules for one period are to be used while responsibility for repairs is assessed under the rules of a different period. The Chicago & Alton in its statement pointed out that it was unable to secure the material for which to repair the car until January 4, 1930, when the repairs were made and the car was released. If it had had the proper material on hand to make repairs or had the material which the car owner furnished been received prior to January 1, 1930, there would have been no question as to its bill being correct.

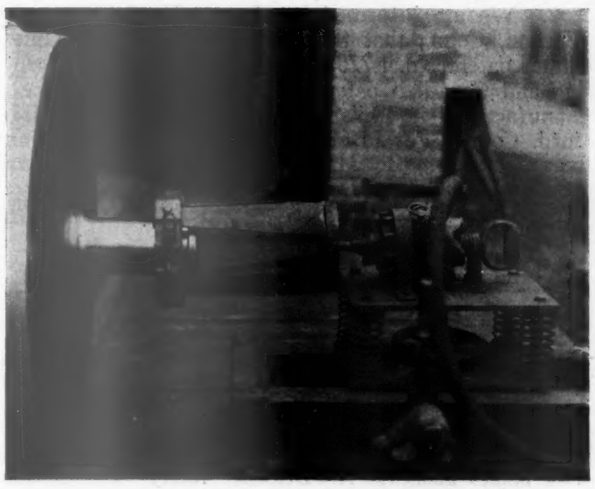
The Arbitration Committee in its decision stated: "Responsibility is governed by rules in effect at time of accident. Prices for repairs are governed by rules in effect on date repairs are completed. The position of the Chicago, Rock Island & Pacific is not sustained. Decision No. 1554 is parallel."—*Case No. 1672, Chicago, Rock Island & Pacific vs. Chicago & Alton.*

A Simple Method of Polishing Journals

A CAR foreman at one of the large western terminals has developed a simple and effective device for polishing journals on passenger-car wheels. Many methods have been used for performing this job but this one seems to be particularly interesting. The illustration shows quite clearly practically all of the equipment except a small air-cylinder turntable jack located in the floor between the rails which is used for turning the wheels end for end. The old style straight-air brake valve seen in the immediate foreground controls this jack.

The polishing machine consists essentially of a No. 2 air motor mounted on a spring platform which, together with a polishing head, is movable back and forth across the length of the journal. The spring platform is mounted on a roller carriage which runs on the lower flanges of a pair of eight-inch I-beams which form the stationary bed for the machine. The motor platform or carriage is in two parts, an upper and lower plate, with springs between and the height of the motor above the top of the rail is readily adjustable by means of a hand wheel.

The polishing head consists of two semi-circular shoes riveted to a hinged frame which permits the two shoes



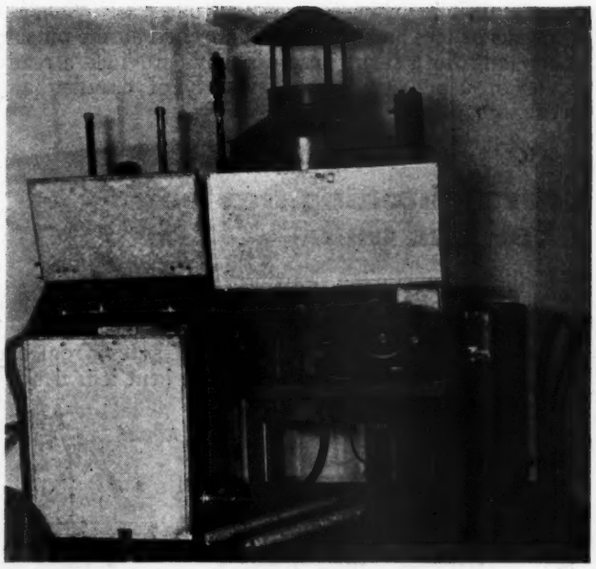
Abrasive cloth between two motor-driven shoes polish a journal in 20 min.

to be spread apart so that they may be slipped over the journal and adjusted to different sizes of journals. The preliminary polishing is accomplished by lining the shoes with No. 00 abrasive cloth and adjusting the pressure of the two shoes on the journals by means of clamp screws. Light oil is then applied to the journal, the motor started and the revolving shoes polish the journal as they are moved back and forth across its length. When the rough polishing is finished pieces of carpet cut to the proper size are substituted for the abrasive cloth and the journal is then given the finishing touches.

The entire operation on a normal journal requires from 15 to 20 min.

Truck for Steaming Water Containers

CONTAINERS used for drinking water on passenger cars have to be cleaned according to the sanitary code and on one railroad at least the job has been simplified by the construction of a compact and complete portable steaming outfit. The nucleus of this equipment was a commercial outfit, the Homestead Hypressure Jenny; which was originally used for steaming out garbage cans and containers from dining rooms and dining cars. The original commercial equipment consists of a flash type steam generator which is fired by an oil burner and is capable of generating steam at pressures up to 250 lb. per sq. in. The flash generator is fed with fuel oil and water by a pair of pumps ac-

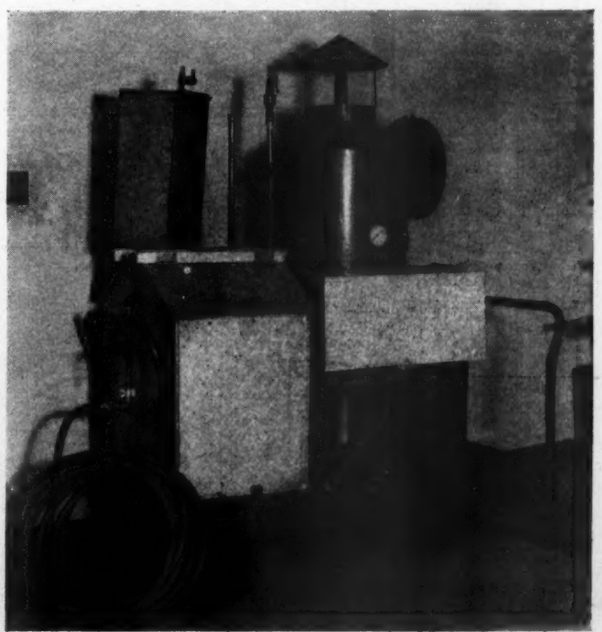


The flash boiler on this steaming outfit is fed with oil and water by motor-driven pumps

tuated by a beam which receives its motion from a cam on a gear wheel. The gear wheel is driven by a pinion on the shaft of a 32-volt motor. By using this type of electrical equipment the outfit is independent of city current supply and may be plugged into a receptacle on an electrically-lighted car.

As reconstructed for steaming water containers the outfit has a large water supply tank of galvanized iron, on top of which is a tray through which project two steam pipes from the generator. These pipes are drilled at intervals with small holes so that the steam under pressure is ejected in all directions. The water containers are placed on the pan over the pipes and the steam turned on by means of separate valves.

The steam supply line passes on through the water

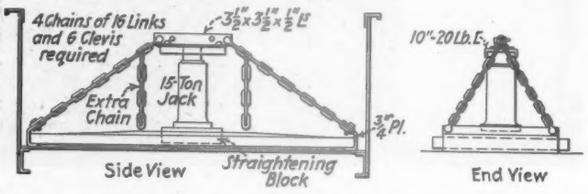


A view of the steaming truck with a water container in position

compartment in which the vertical pipes are taken off by means of tees and ends in a connection on the outside of the tank for a steam hose. Thus is provided a ready means of using steam for a variety of cleaning and sterilizing purposes.

Straightening Device For End Gates

IN the accompanying drawing is shown a device for use in straightening pressed steel end gates, either the plain or corrugated types. This device can be used effectively without removing the end gates from the car. Where corrugated end gates are bent it is desire-

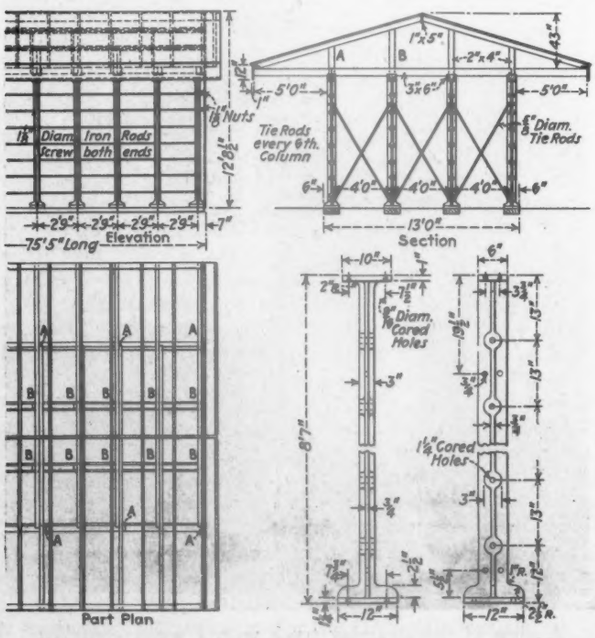


Details of a handy straightening device for end gates

able to set an oak block in the corrugation under the jack. This will permit the original contour to be maintained and no evidence of straightening can be detected. From 15 to 20 min. is all the time that is required to straighten up an end gate to its original shape and the end gates in both ends of the car can easily be straightened in about 30 min.

Rack for Storing Bar Iron and Pipe

THE rack shown in the drawing is used by an eastern railroad for storing bar iron and pipe. The columns are of cast iron with 1¼-in. cored holes spaced 13 in. apart. Rods 1⅛ in. in diameter are inserted through these holes, as shown. The bases of the columns are 12 in. by 12 in. and have four 13/16-in. cored holes for ¾-in. bolts or studs imbedded in the concrete foundation or floor. The roof is covered with asphalt roofing.



Outdoor rack for the convenient storing of bar iron or pipe

Stand for Repairing Distributing Valves

A DESCRIPTION of a stand for repairing triple and distributing valves was published in the May, 1931, issue of the *Railway Mechanical Engineer*, page 252. We are informed by George H. Andrews, Jr., Vernon, Conn., that this stand is covered by United States patent No. 1,729,812, United States patent pending and Canadian patent No. 311,171. The device is manufactured in Philadelphia, Pa., and in East Hartford, Conn. For information relative to its sale and manufacture, write Mr. Andrews at Vernon, Conn., or Box 847, Hartford, Conn.

Questions and Answers For Air-Brake Foremen

FOLLOWING is the third group of questions and answers selected from the instruction pamphlet recently revised by an eastern road:

Q.—What may cause leakage from the emergency exhaust port of an automatic brake valve when in lap position brakes applied? A.—Defective rotary valve or seat.

Q.—What may cause leakage from a straight-air brake-valve exhaust when brakes are applied in service? A.—Indicates that the double-seated check valve is leaking on the straight-air side.

Q.—What may cause leakage from the brake-cylinder exhaust of the distributing valve with brakes applied? A.—Defective distributing-valve exhaust valve.

Q.—What may cause an intermittent blow from the brake-cylinder exhaust of a distributing valve with brakes applied? A.—Indicates a weak or broken application-piston graduating spring, a defective distributing-valve gasket, high friction in the application portion, or application valve leaking.

Q.—What may cause leakage from the triple-valve exhaust with brakes applied? A.—A defective slide valve or seat.

Q.—What may cause leakage from an exhaust port of a brake-pipe vent valve with brakes applied? A.—A defective emergency slide valve, lower gasket or quick-action valve seat.

Q.—What may cause an intermittent or continuous blow at the distributing-valve brake-cylinder exhaust until brake-cylinder pressure is depleted? A.—A defective application-cylinder cover gasket, application-cylinder or chamber, application-cylinder pipe or fittings, independent-brake-valve lower gasket, defective independent or automatic rotary valve or seat and leaking distributing-valve equalizing slide or graduating valve.

Q.—Name some distributing valve defects which may prevent an application of brakes from a brake-pipe reduction of 5 lb. A.—A defective distributing valve, equalizing piston ring too loose in the groove or cylinder, or worn equalizing-piston cylinder bushing, feed groove too large, pressure chamber not fully charged or leaking, leaks from the application chamber, cylinder, pipe or connections.

Q.—Name some defects in a brake valve which may prevent brake application on a 5-lb. brake-pipe reduction. A.—Preliminary exhaust port restricted, resulting in slow rate of brake-pipe reduction; leaking automatic or brake valve rotaries; leaking bottom gasket independent brake valve, U pipe removed.

Q.—What happens if the application-cylinder and distributing-valve release pipes are crossed (No. 6 ET) with

the U pipe leaking or omitted? A.—Brakes will not apply.

Q.—What defects in A-1 or combined automatic and straight-air brake equipment may prevent brakes from applying on a brake-pipe reduction of 5 lb. A.—Auxiliary reservoir not fully charged or leaking; feed groove too large; leaking brake cylinder or related piping or defective brake-cylinder packing; restricted preliminary exhaust port (resulting in slow rate of brake-pipe reduction); leaking double-seated check valve (straight-air side); triple piston ring too loose in the groove or cylinder, or worn triple piston cylinder bushing; high friction in service parts; leaking high-speed reducing valve or safety valve.

Q.—What may cause an increase of equalizing-reservoir pressure with the automatic brake valve in lap position? A.—A leaking rotary or middle gasket of a six-position brake valve or leaking rotary or bottom gasket of a five-position brake valve.

Q.—What is indicated by a decrease of equalizing-reservoir pressure with the automatic brake valve in lap position? A.—A leak from the equalizing reservoir or the related piping, including the tube in the gage.

Q.—Will this condition cause the equalizing piston to lift and brake-pipe air to discharge through the service exhaust? A.—It may, unless the rate of brake-pipe leakage equals or exceeds the rate of equalizing-reservoir-pressure leakage.

Q.—What may happen on a light engine if the brake-pipe leakage is excessive with brake valves of the collapsible type? A.—Equalizing-reservoir pressure may force the equalizing piston of collapsible type down and allow pressure above the equalizing piston to reduce through the by-pass grooves.

Q.—How may the brake-pipe leakage be known on engines equipped with combined straight-air and automatic, or A-1 equipment. A.—By applying test device to brake-pipe hose coupling; then open the angle cock and read the gage after making required brake application and with the automatic brake valve in lap position. The drop in a given time will indicate the rate of brake-pipe leakage.

Q.—What may cause brakes to release with ET or EL equipment with the automatic brake valve in lap position and the independent-brake valve in running position following a 10-lb. service reduction? A.—Leaking application chamber or cylinder, application-cylinder pipe or connections, application-cylinder cover gasket or application packing cup or leather, defective distributing-valve gasket, defective automatic or independent rotaries or seats, or independent brake-valve lower gasket. In addition to the foregoing, a leaking distributing-valve equalizing or graduating valve, or increase of brake-pipe pressure may cause a release with No. 6 ET equipment (U pipe removed).

Q.—What may cause brakes to release with A-1 or combined straight-air and automatic equipment after a partial service brake application? A.—Leaking graduating valve or auxiliary reservoir, leak of main-reservoir air into the brake pipe due to a defective automatic rotary valve or seat, leaking brake cylinder or related piping, brake-cylinder pressure-head gaskets, packing cup or leather, double-seated check valve, high-speed reducing valve or safety valve.

Q.—What may prevent air from discharging at the independent brake-valve warning port with the handle in a release position? A.—Warning port may be obstructed, or it may be due to absence of pressure above the rotary valve.

Q.—Should air discharge from the brake-pipe vent valve with the automatic brake valve in service position? A.—Yes.

Q.—What may cause failure? A.—A loose emergency-piston ring or ball check not seating.

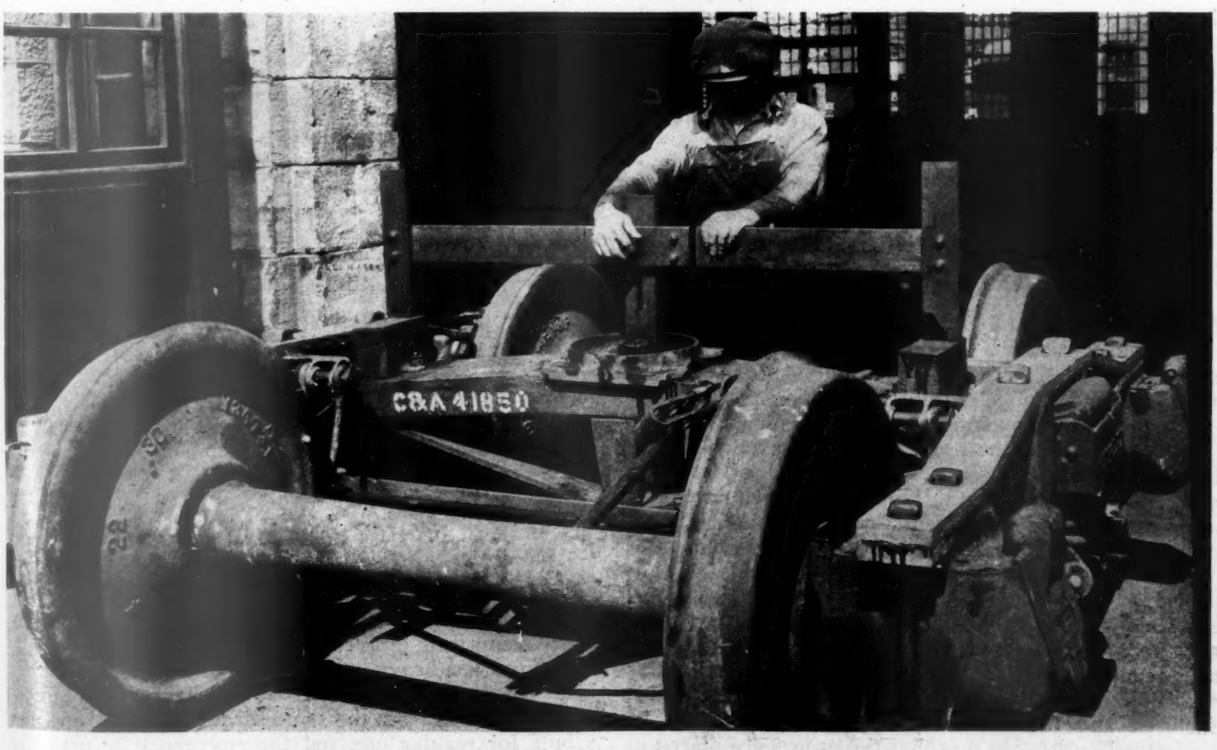
Q.—What may cause a vent valve to move to emergency position during a service reduction? A.—High friction of the emergency slide valve or piston, service port obstructed, or weak or broken emergency piston spring.

Q.—Explain how to determine if the application-cylinder pipe and distributing-valve release pipe are crossed. A.—Make a service brake application, place the independent-brake valve in release position. If pipes are crossed it will be impossible to release the brakes with the independent-brake valve following a service application.

Q.—What would be the result if the U pipe were removed or leaking? A.—With the independent brake valve in running position it would be impossible to make a service application.

Q.—How can it be determined whether or not the preliminary exhaust is of the proper size? A.—By charging the brake system; then make a 20-lb. reduction, which should require approximately 6, 8, and 10 sec. from an initial pressure of 110, 90 and 70 lb. pressure, respectively, with standard equalizing reservoir of 10 in. by 14½ in.

* * * *



No measurements are necessary with this adjustable side bearing gage used at Chicago & Alton car shop, Bloomington, Ill., to assure the right amount of play on side bearings on first trial

In the Back Shop and Enginehouse

A Simple Reamer Check

THE device shown was devised to check reamers and the bolts to be fitted to the holes reamed. The centers are permanently fixed at the standard taper and all reamers, before being issued from the tool room, are checked for accuracy by means of the gage indicator

A dial gage and permanent centers permit the accurate checking of reamers and bolts

mounted on a sliding carriage. The warping of a reamer in tempering or an error in taper are readily detected, the latter also being true of the bolt to be fitted.

Disputes as to where the errors occurred in ill-fitting bolts are reduced to a negligible point, as it is extremely difficult for a misfit to occur after both reamer and bolt have been subjected to this test. The centers, being permanently fixed, permit of no deviation such as may occur if they are adjustable and the greatest precision is insured.

Handling Shop Orders On the Norfolk & Western

THE Northern and Southern branch lines of the Norfolk & Western from Hagerstown, Md., to Winston-Salem, N. C., cross the main line at Roanoke, Va., thus making Roanoke the hub of the system and easily accessible to all shipping points and terminals. Consequently, more than the usual amount of manufacturing is done at Roanoke shops. The method of handling shop orders, described in this article, has been developed after considerable experimentation and has been found to be flexible and admirably suited to the requirements.

After passing through the proper channels for approval, all stock books for shop-made articles and requisitions for non-stock shop-made articles are turned over to a shop-order clerk who issues all orders for shop-manufactured materials. This clerk is familiar with the kind of material required for each item manufactured and the nature of the work that is to be performed on it. He sees that the orders are placed in each department concerned in the production of the material wanted, and arranges for the shops to be furnished with all necessary drawings and information.

The Norfolk & Western uses two kinds of orders, individual and standard. The individual orders are issued in sequence and cover items on which the exact cost of production is desired. Provision is made for all labor and material expended in manufacturing or repairing to be charged against each order, to which the shop expenses are added.

Standing orders are used for the manufacture of commonly-used materials for which an average cost is satisfactory. The standing-order accounts are closed out monthly and a six-month average cost found to be used for the succeeding six months. Any variation in the cost of manufacturing will be equalized over a six-months' period, and, in addition, will assure uniformity in prices.

Each order card, whether individual or standing, carries an entry number immediately below it which is for ready reference, especially in filing. Entry numbers are always in sequence. There are 10,000 entries in a series and when these are exhausted the next series is started with number one.

There are 102 standing orders covering the manufacture of frequently-used materials, several of which are shown for purposes of illustration:

Norfolk and Western Railway Company
Roanoke Shop Work Order

Order 29996
Entry 2917
Series 105
Drawing

Date 2/9/31 Quantity 1

Sec. Item Req HFF 238 to fol Auth.

Pattern

Ship to Mr. Williamson, W. Va.

COPIES AS INDICATED

Supt. Shops	1	Pipe and Tin	
G. F. C.	1	Foundry	
Storekeeper	2	Passenger	
Yd. Master	1	Freight	
Boilers		Paint	
Frog		Planing Mill	
Machine		Wheel	
Smith		Yard	
Grinding		Stay Inspector	
Roller	2	Supt. Car Dept.	

Specification

M-1 Front Flue Sheet - Engine 1002

Kind Material Gross Wt. Net Wt.

Date Completed Date Shipped Rec'd by

The Norfolk & Western work order form

Order No.	Parts Manufactured
510	Cast steel, rough castings
511	Cast iron, rough castings
513	Bronze and brass rough castings
514	Miscellaneous forgings
516	Car forgings
517	Engine forgings
521	Rivets
530	Elliptical springs (manufacturing and repairing.)

The shop order cards are made of semi-stiff cardboard comprising ditto copies of Form GS73, illustrated. This form is a heavy, white paper, printed with copying ink. Blank shop order cards are available in three colors (all dittoed from the same form GS73) and include a buff for regular use, red for emergency or material needed at once, and yellow for special authority work.

The red, or emergency, card is given preferred attention by all departments, and the material rushed through with all possible speed. The yellow, or special authority, card is issued for new equipment on which special authority is required and is a safeguard against improper charges. As an additional safeguard, the order numbers of all special authority cards are prefixed by the letter "X."

The shop-order cards are issued to each department as required. If rough castings are ordered, three copies of the cards are sent to the foundry, one going to the pattern shop, one to the foundry office and one to the foundry shipping department. When the material is finished and ready for shipment, it is turned over to the storehouse and the foundry takes a receipt for the material delivered.

If two or more departments participate in the manufacture of an item, the originating department takes a receipt on turning the material over to the intermediate or finishing department. The originating department sends its card to the shop-order clerk who makes a note of the date and in this way can keep in touch with the progress of the material through the shops. When the finishing department delivers the material to the stores department, a final closing card is given to the shop-order clerk who forwards it to the office of the shop superintendent when the shop accounting is done. From this office, all charges are made and the general storekeeper is billed with the cost of production. These charges are carried in the M. & S. account until the material is shipped or issued to the user and the M. & S. account cleared. Copies of standing orders are not sent to the office of the shop superintendent as the labor and material expended on these orders are taken from individual time cards.

Prony-Brake Arrangement For Testing Air Motors

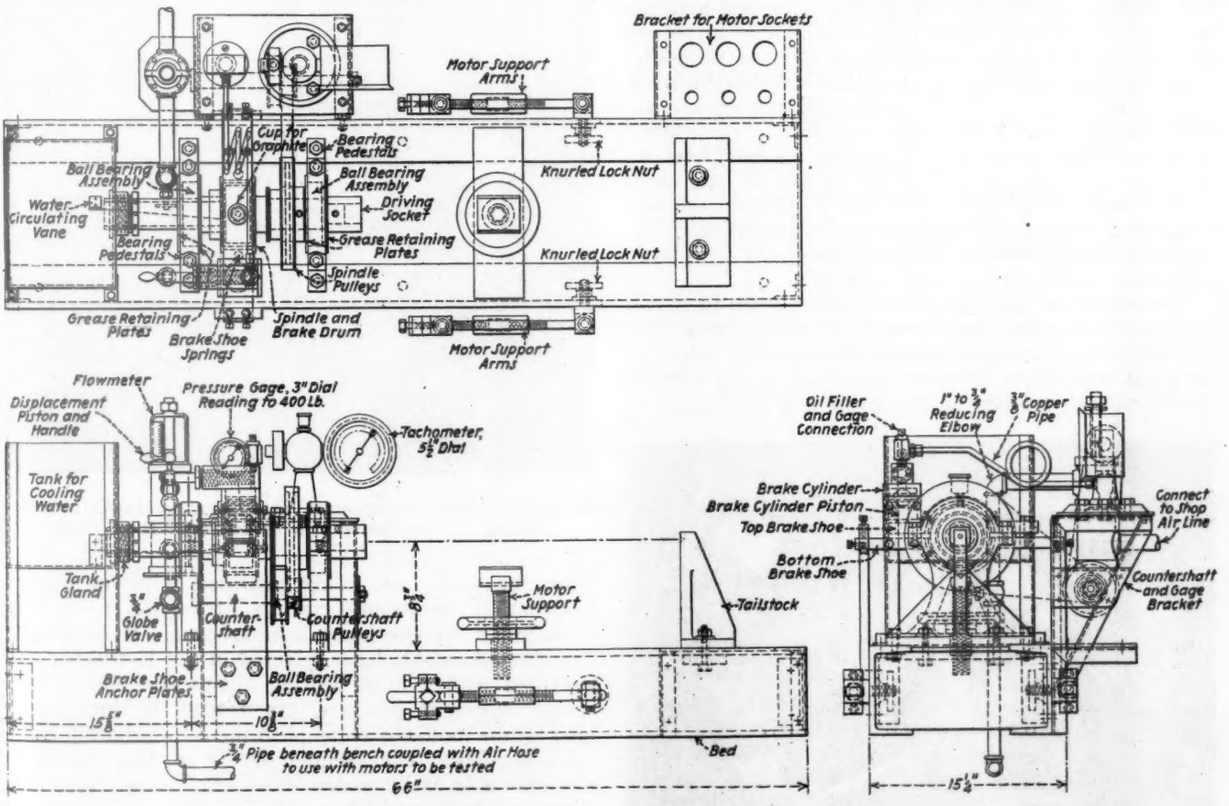
ONE of the important jobs in a tool room or shop test department is the testing of compressed-air tools to ascertain that each motor operates at its rated capacity with respect to output and air consumption. The prony-brake arrangement shown in the drawing is used for testing the motors of compressed-air tools.

The motor is placed on the motor support between the two support arms and ahead of the tail stock. Both the support and support arms are designed for close adjustment. The tail stock is clamped to the bed and can also be adjusted to suit the size of the motor.

It is connected to the driving socket which operates the spindle to the pulley for driving the tachometer and also the prony-brake drum. The brake shoes are lubricated with graphite, as shown. Provision is also made for the circulation of cooling water.

The prony-brake arm exerts pressure on the brake-cylinder piston. This pressure is registered on the air-pressure gage, which shows readings up to 400 lb. The tachometer has a 5½-in. dial and shows the instantaneous speed of the motor at speeds from 100 to 1,000 r.p.m. Compressed air to the motor from the shop air line passes through a flow meter which measures the quantity of air consumed by the motor. Provision is made for regulating the amount of air displaced from the air cylinder by means of a displacement piston and handle, as shown.

The countershaft is used when testing slow-operating motors. With this belt arrangement, the tachometer reading is divided by four. When fast-operating motors are being tested, the belt drive is made directly from the brake spindle to the tachometer. The area of the



Apparatus for testing air-operated motors in the shop

brake cylinder is 5 sq. in. To ascertain the force exerted by the brake arm on the air-cylinder piston, the air-gage reading is multiplied by 5.

Set screws are provided to adjust the brake shoes on the drum. These screws should be adjusted so that the top and bottom shoes are clear of the drum when there is no pressure on the brake.

The flowmeter used with this equipment is manufactured by the New Jersey Meter Company, Plainfield, N. J., and the tachometer is a Columbia speed recorder manufactured by Fairbanks, Morse & Co., Chicago. The ball-bearing assemblies used on the brake-spindle bearings are from a Stone-Franklin car generator type No. 50, while the bearing assemblies for the countershaft are from a No. 4 Little Giant compressed-air grinder.

Two Boiler-Shop Devices

SHOP devices which contribute either to safety or increased production are always welcome in the boiler shop and of general interest to boiler-shop foremen and supervisors. The first of those illustrated in this article comprises a special valve inserted between the air hose and the motor operating handle to permit shutting off the motor instantly, in case of necessity, while reaming and tapping mud-plug holes or blow-off cock holes. The reversible compound piston-type air motor is suspended at the proper elevation by means of a chain and hook inserted in a flexible staybolt hole, as this type of motor weighs about 54 lb. A long dead lever is used, being held by a helper to prevent the motor getting away from the operator in case of sticking, which is always more or less of a possibility with large holes such as this 2¼-in. mud-plug hole.

The additional control valve, plainly shown in the illustration, is a spring-lever valve which remains open only while the handle is pressed down by the helper at the right, and closes instantly on release of the lever in case the large reamer or tap gives any indication of sticking. The closing of this valve shuts off the supply of air to the motor immediately and stops the motor even quicker than could be done by the use of the usual handle control valve.

Reaming boiler washout-plug hole with Thor 33-L air motor. A special quick-action shut-off valve is provided in the air line

With this method of operation and arrangement of the motor the boiler maker in the center is left free to devote his entire attention to lining the motor up properly and making sure that the reaming or tapping operation proceeds at the proper rate for the best results.

Special Lever Feeding Arrangement

The second illustration shows the use of a Thor No. 9 close-quarter air drill in countersinking rivet holes in the flange of a fire-door sheet, using a special U-shaped hook-and-lever arrangement for feeding the drill. As illustrated, this device consists of a U-shaped forging, the two legs of which are about 24 in. apart and 10 in. long, the outer one being provided with an inward horizontally projecting end to fit in the rivet hole adjacent to the one being counterbored. By means of the long adjustable lever, pivoted in the U-forging and provided with a head bearing against the motor feed screw, sufficient pressure can readily be brought to bear on the motor to accomplish the counterboring operation quickly. The feeding device is then moved to the next hole easily and without any loss of time. By means of the bolt and four holes shown in the U-shaped forging, this device can be quickly adjusted for use with different sizes of motor or different lengths of counterboring tool.

A special lever arrangement facilitates the rapid countersinking of rivet holes in a firebox door-sheet flange

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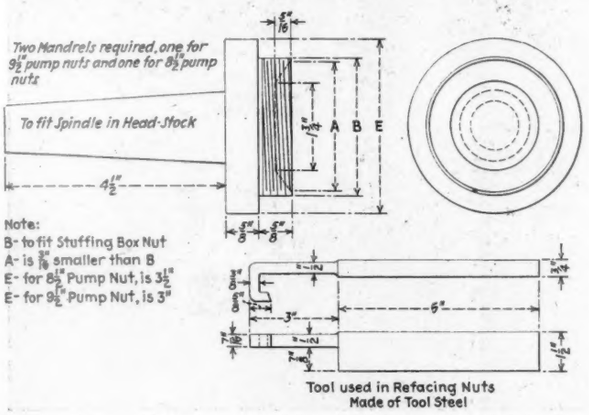
TWENTY-FIVE YEARS AGO.—The Master Car Builders Association has adopted a rule which requires that all cars offered in interchange after September 1, 1907, must be equipped with air brakes. The Interstate Commerce Commission has issued an order that the minimum percentage of air braked cars in trains used in interstate commerce shall be increased to 75 per cent on and after August 1, 1906.—Railway Age, November 24, 1905.

Reclaiming Stuffing-Box Nuts on Compressors

By E. G. Jones

STUFFING-BOX nuts which are used repeatedly during the operation of air compressors finally become grooved and shouldered and are in many cases thrown into the scrap pile. This is a waste of material, for they can be easily and accurately reclaimed.

The nut is screwed on the mandrel and is refaced from the inside by the reversed facing tool as shown. A nut


Two Mandrels required, one for 9½" pump nuts and one for 8½" pump nuts
To fit Spindle in Head-Stock
4½"
A B E
Note:
B- to fit Stuffing Box Nut
A- is 1/16" smaller than B
E- for 8½" Pump Nut, is 3½"
E- for 9½" Pump Nut, is 3"
3"
6"
Tool used in Refacing Nuts Made of Tool Steel

Mandrel for reclaiming stuffing-box nuts on air compressors

does not require much facing to reclaim it and it is no difficult task to accomplish with this mandrel and tool. The life of a stuffing-box nut in many instances is doubled and sometimes tripled.

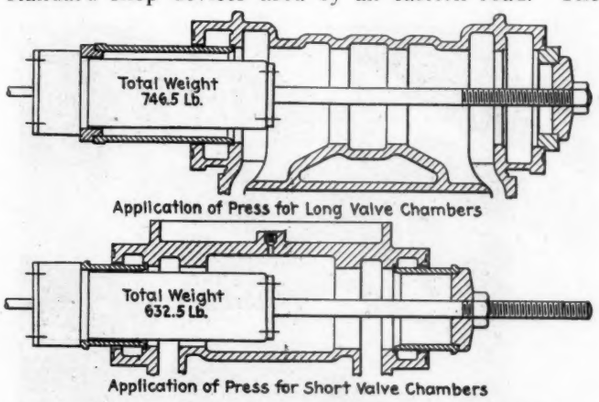
If the face of a stuffing-box nut is not in alinement with the threads, it will cause considerable leakage by the metallic packing where it is intended to make a seal. If the nut is grooved and shouldered, this leakage is obviously great and the method shown of reclaiming these nuts eliminates this undue leakage by properly alining the new face with the threads in the nut.

The mandrel is made of steel and the tapered end is made to fit the spindle in the head stock of a lathe. The nut is screwed on the mandrel and strikes the shoulder of the mandrel, which leaves enough space between the mandrel and the face which is to be reclaimed that the tool may be entered.

Where 8½-in. and 9½-in. air compressors are maintained, two mandrels are required.

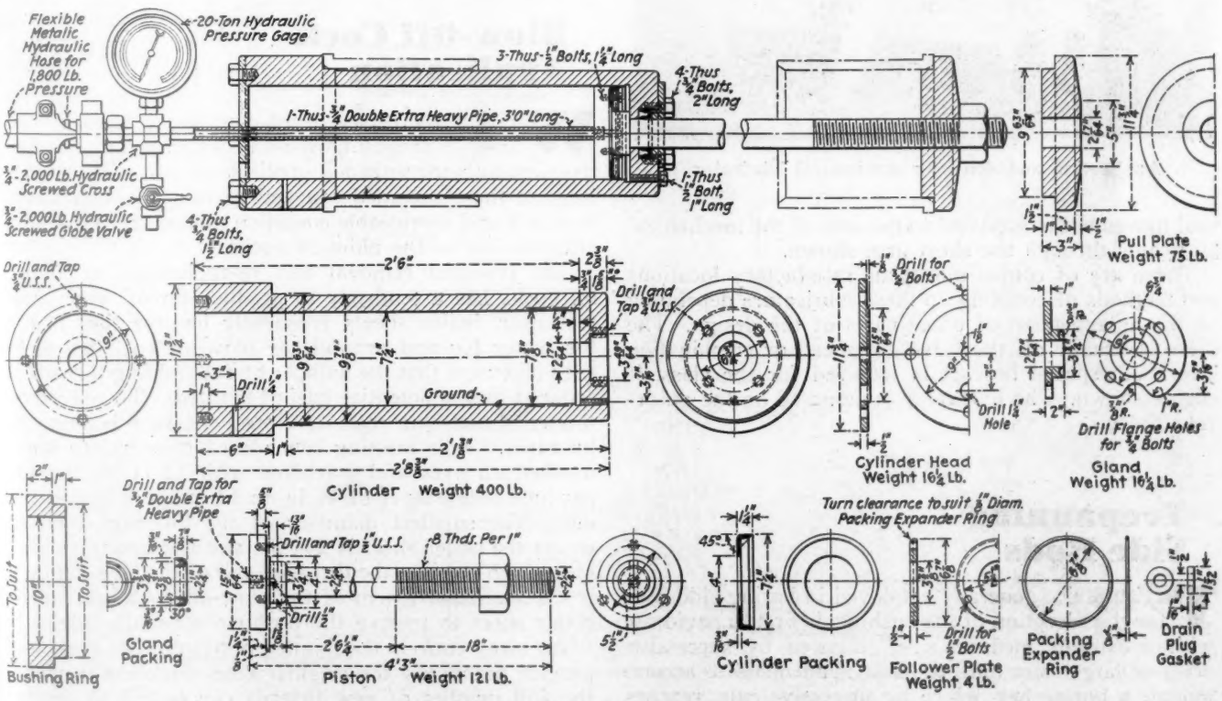
Hydraulic Press for Pulling Valve Bushings

THE hydraulic press, the details and application of which are shown in the two drawings, is one of the standard shop devices used by an eastern road. The


Total Weight 746.5 Lb.
Application of Press for Long Valve Chambers
Total Weight 632.5 Lb.
Application of Press for Short Valve Chambers

Application of the hydraulic pulling press for short and long valve chambers

cylinder is of axle steel, bored 7¼ in. diameter. The piston and piston rod, as well as the various small parts,



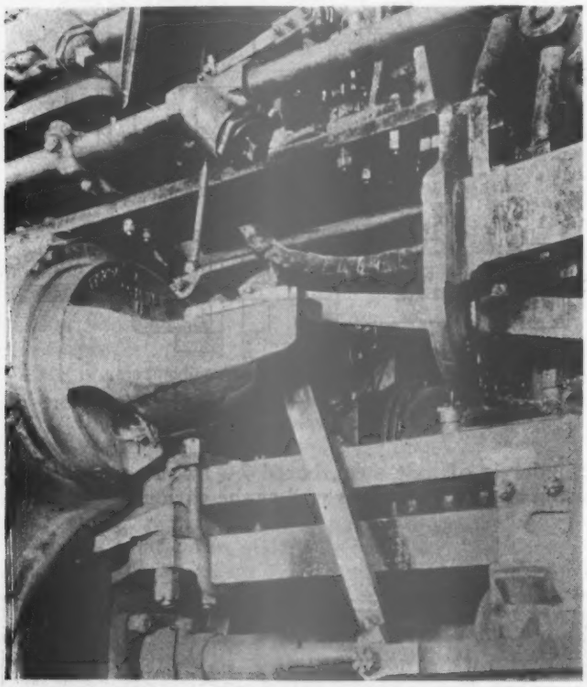
Assembly and details of the hydraulic press for pulling in valve bushings

are of machine steel. The drain-plug gasket is of copper. Leather is the material used for the cylinder packing cup.

This press may be used for pulling the bushings in valves having long or short chambers. In the case of a long valve chamber, a bushing ring is provided, which is placed over the cylinder, as shown.

Convenient Drive for A Mechanical Lubricator

SHOWN in the illustration is a neat arrangement for operating a mechanical lubricator. An extension plate is welded to the top of the combination lever and extends a few inches in front of the center line of the lever. As the lever rocks back and forth, sufficient ver-



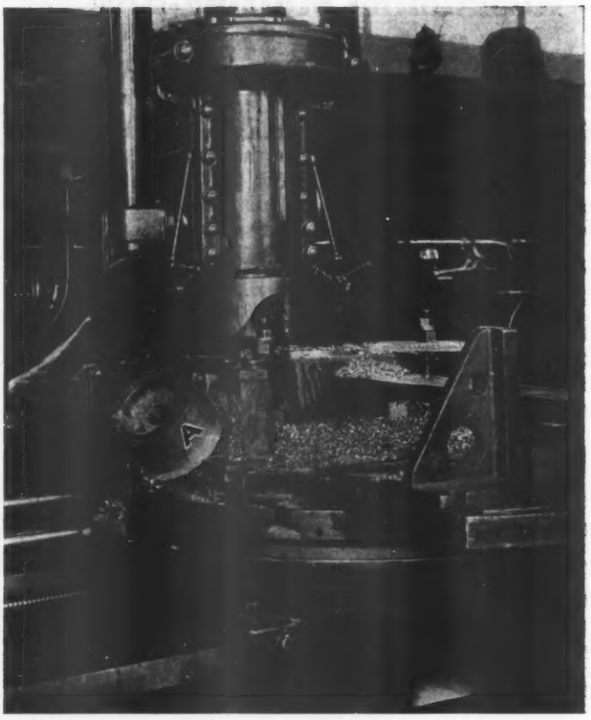
Application and drive for mechanical lubricator

tical movement is imparted to the arm of the mechanical lubricator through the short arm shown.

There are of course numerous satisfactory locations and methods of coupling up these lubricators depending on the arrangement of other parts of the design. The drive is usually off the valve crosshead or combination lever. No special bracket is required for the class of engine shown. The lubricator is mounted on the guide-yoke brace.

Trepanning Side Rods

THE practice generally employed in boring side rods for the reception of the bushing, is first to perforate with a drill of medium size, followed by successive drills of larger size until the hole is adequate to accommodate a boring bar, which by successive cuts, reaches the finished size. The core marked *"A"* to the left of



Trepanning out the piece marked A completed in 50 min.

the illustration is evidence of the efficiency of this trepanning tool and was cut out in 50 min. flat or just 3 hr. 10. min. less than under the former method described.

The trepan is simply a cylindrical cutter with three teeth having but slight clearance for chips and is shown operated by an Ingersoll vertical milling machine.

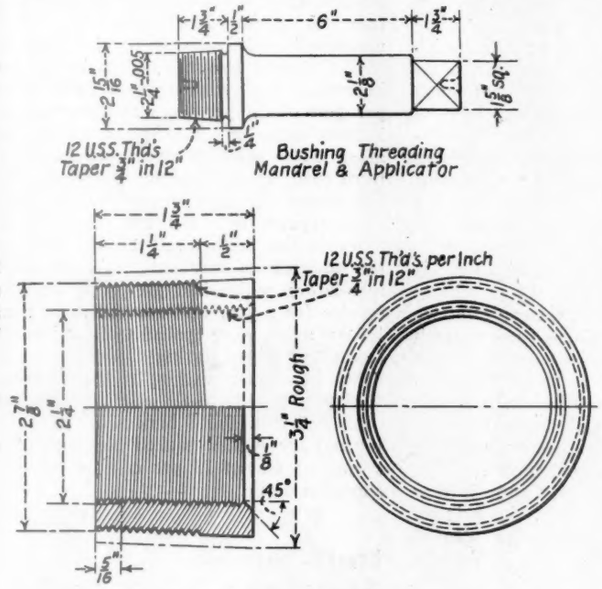
Blow-Off Cock Application

WHILE there is a decided tendency towards the use of flanged blow-off cocks on steam locomotives, many with threaded applications are still in service, and these threaded connections must be maintained in a safe and serviceable condition during the remaining effective life of the blow-off cocks.

The repeated removal and re-application of blow-off cocks has a tendency to produce thread wear and, moreover, boiler sheets frequently become thin inside the water leg and around the blow-off cock holes, to such an extent that the number of full holding threads is reduced and a potential hazard created. To overcome this condition, one road developed the steel bushing illustrated. This bushing is made of open-hearth steel, finished all over and machined with 12 U. S. threads per inch and a taper of ¾ in. in 12 in., both inside and out. The smallest diameter of the bushing where it enters the boiler sheet is 2⅞ in., and the smallest diameter which receives the threaded end of the blow-off cock is 2¼ in. Enlargment of the blow-off cock hole in the boiler sheet to receive the bushing is usually adequate to cut away entirely the thinned portion of the sheet and provide practically the original sheet thickness in which the full number of new threads can be cut to receive the bushing. A fillet of electric-welded metal is then

applied between the boiler sheet and the bushing, which greatly strengthens the construction and prevents the bushing from backing out when the blow-off cock is being removed.

The bushing illustrated is made from 3½-in. tubular open-hearth steel stock threaded on the interior diameter



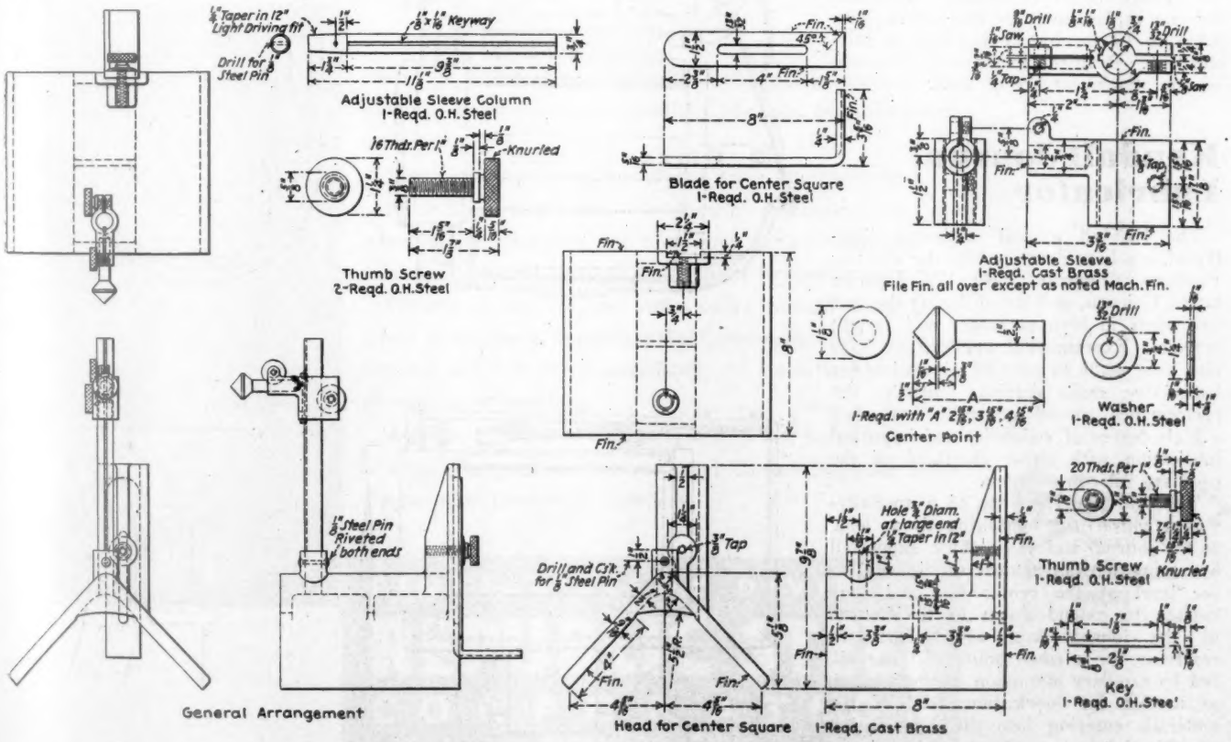
Details of a bushing used for the improved application of screw-type blow-off cocks

and cut off to the required length in a turret lathe. The mandrel illustrated in the upper right corner of the drawing is then threaded into the bushing and used to support it in an engine lathe, while the outside of the bushing is being cut to the required taper and threaded. The mandrel is provided with centers and one end cut to a square to receive the lathe dog used in the turning operation. This mandrel also proves very useful in applying the bushing to the boiler sheet, assuring that this will be done without damage to the bushing. The design of the mandrel is such that it can be used to turn the bushing solidly into place, a reverse movement readily releasing it, since the shoulder prevents any binding on the threads.

Locating the Center Line Of a Locomotive Crank Pin

SHOWN in the drawing are the details and general arrangement of a center square for locating the center line of the crank pin on the driving-wheel axle. The head and adjustable sleeve are of cast brass, the latter being file finished all over except where marked on the drawing for machine finish. The remaining parts are of steel.

TIMEKEEPERS on the Italian State Railways, it would seem, must be expert mathematicians, certainly with some knowledge of calculus. They need it to figure the rates of pay of enginemen and firemen. As explained by an Italian road foreman of engines, there is a basic rate for these men. This is subject to a percentage increase for every five years of satisfactory service. To this rate is added the working rate, which is based on the number of kilometers run and the time consumed in making the run. A further percentage is added for fuel economy, together with additional pay for night operation. In freight service, the tonnage handled is also taken into consideration. The rates of pay in engine service run from 1,200 lire to 2,100 lire per month, the lire being quoted at five cents, United States money. These involved calculations are a part of the general plan on the Italian railways to bring about orderliness and efficiency in operation, a plan which is proving more successful each year.

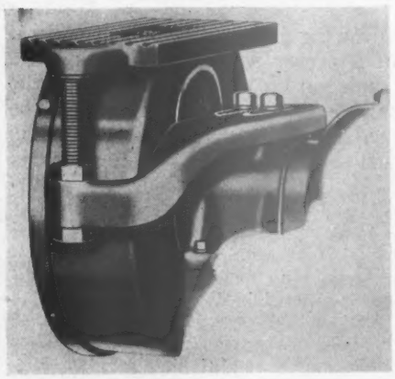


Center square for locating the center line of the crank pin on the driving-wheel axle

NEW DEVICES

Surface-Grinding Attachment

The Hisey Wolf Machine Company, Cincinnati, Ohio, has recently placed on the market a surface-grinding attachment for floor grinders which may be interchanged with the standard wheel



Hisey-Wolf surface grinding attachment which interchanges with the wheel guard

guard equipment on either side of the machine. The table is adjustable to the wear of the wheel through two square-thread screws which are locked rigidly in place by means of two opposed nuts. The guard cover is readily removable for the replacement of the wheel. The table is 10 in. by 21 in. and is self-cleaning. Both the guard and the cover on the attachment are of steel.

Kendall Journal Lubricator

The Kendall journal lubricator, illustrated, has been developed by the Railway Products Company, 5949 W. Superior street, Chicago, and tested during the past two years in both passenger and freight service. Experimental applications have also been made to provide lubrication for locomotive main driving journals, the performance record generally indicating a high degree of reliability and improved lubrication with about one-third of the ordinary oil consumption.

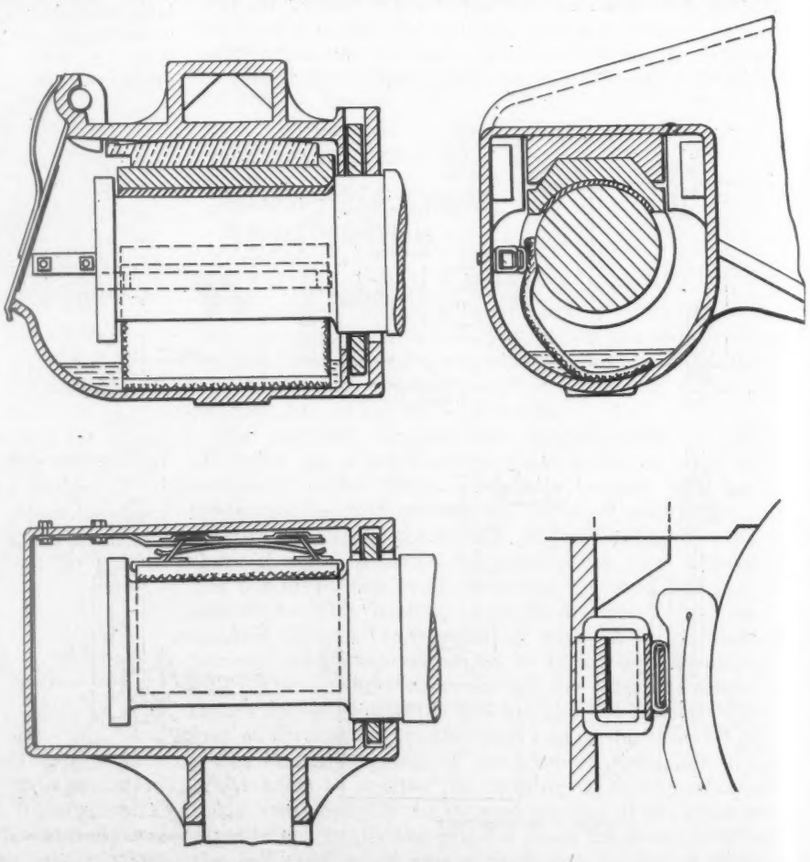
The lubricator consists of a specially-woven cotton pad, approximately as wide as the journal and ⅜ in. thick, supported by spring tension against the journal at the level of the center line and long enough to extend down to the bottom of the journal box which forms a reservoir for a small amount of car oil, fed by capillary attraction to the journal, as needed for lubrication. All of the materials entering into the construction of this lubricator are relatively inexpensive to procure and the device can be quickly and easily applied to the interior of any standard journal box. The lubricating pad is secured to a brass strip which is in turn locked to a pressure bar, flexibly spring supported from another small bar rigidly held in the journal box by two small bolts. The connection is sufficiently flexible to allow the lubricating pad to follow any normal end movement of the journal in the box and it does not interfere in any way with jacking the box for the examination or renewal of brasses. This type of construction is designed to do away with the possibility of "waste grabs" and provide an effective supply of lubricant to the journal at small expense for initial application and with substantially less subsequent inspection and attention to secure freedom from hot boxes than would be the case with oil and waste packing ordinarily used in standard A. R. A. journal boxes.

The Kendall journal lubricator is now in test service on 10 roads, the original installation having made over 240,000 miles since first being placed in through passenger-coach service in June, 1929. Experience with these tests is said to have indicated an entire freedom from failure due to "glazing," the presence of dirt, water, snow or ice in the box, or the accumulation of lint working under the brass to cause a hot box. Terminal attention to these lubricators has been minimized and confined to the application of a small amount of oil at infrequent intervals. One road reports 2,000 miles per pint of oil per box; another reports 100,000 miles on 26.38 pints of oil, or about 3,800 miles per pint per box. A third road, however, which installed eight test boxes on a passenger car in April, 1931, reports that the car made 10,098 miles in the next three months without the addition of any extra oil. Kendall lubricators, which had previously been in service for a year and covered more than 100,000 miles, were applied to four journal boxes and sealed during a 30-day test, in which an oil consumption of .01687 ounces per mile per journal was reported, as compared with .05968 ounces per mile per journal for A.R.A. packed bearings, or a saving of almost 72 per cent in oil consumption alone.

Duff-Norton Aluminum Alloy Jacks

The Duff-Norton Manufacturing Company, Pittsburgh, Pa., has recently placed on the market a ball-bearing journal jack

(Continued on next left-hand page)

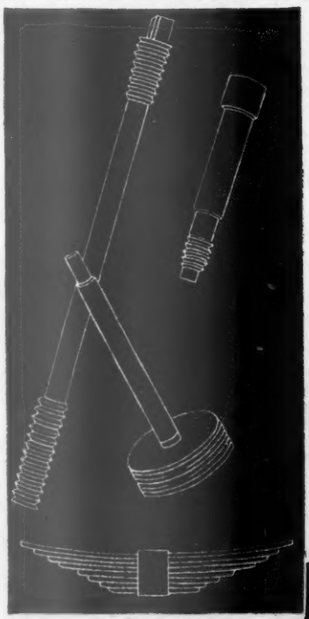


Sections of the Kendall lubricator applied to a standard A. R. A. journal box

AGATHON NICKEL IRON

ALLOY STEELS

are removing old limits of DESIGN



MANY AN IDEA for improving locomotive performance in the past has been modified regretfully because of inadequate materials.

Today many of these handicaps have been removed.

Alloy Steels and Irons, developed by Republic Steel Corporation metallurgists, are providing better resistance to corrosion, greater strength and higher fatigue resistance.

Whether it be springs, rods, axles, motion work pins, tubes or staybolts, Republic Steel Corporation has carefully worked out a material specifically to meet the conditions of modern railroading.

A material that will be stronger and last longer.

Wherever you use iron or steel, consult Republic Steel Corporation for better materials.

REG. U.S. PAT. OFF.
TONCAN COPPER
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CENTRAL ALLOY DIVISION
REPUBLIC STEEL
CORPORATION
Massillon, Ohio

of the car-inspector type with a one-piece "Alcoa" aluminum-alloy shell. The new jacks are furnished in two capacities—15 and 25 tons—and the total weight is 19 and 26 lb., respectively. Both sizes are 10 in. high and have a 5-in. lift.

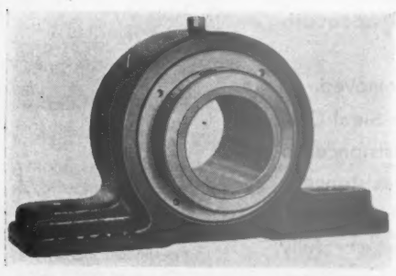
The special features of these jacks are the one-piece aluminum alloy shell, a

The aluminum-alloy jack of 15-ton capacity weighs only 19 lb.

lifting standard of cold-drawn seamless steel with a forged-steel top and a special positive stop safety feature. The special safety stop prevents the lifting standard from being run out of the base.

Shafer Roller-Bearing Units

An entirely new line of Shafer self-alining roller bearing units for normal duty applications has recently been announced by the Shafer Bearing Corporation, Chicago. Shafer double-row self-alining roller bearings as used in the



A pillow block fitted with Shafer self-alining roller bearing

standard-duty units are now available in these lighter, compact housings. The normal-duty units are furnished as pillow blocks, flange units, and take-up units, in a full range of shaft sizes from ¾ in. to 3 in.

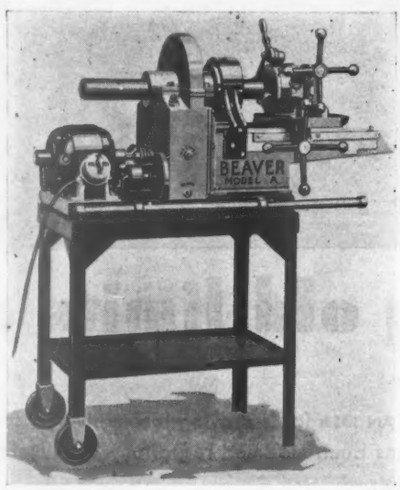
The inner race of the bearing is extended on one end only and fastened to the shaft by a special locking collar, providing ample capacity for the intended service and a simplified application of the unit on the shaft. The sealing of the normal duty unit is accomplished by a grease seal consisting of two steel stampings pressed into the housing or cover. Between these stampings is a 3/32-in. fibre washer which is a slip fit on the extended cone. The seal effectively excludes dirt and other abrasive materials, retains lubricant and prevents leakage.

The flange unit may be bolted to the side of a machine frame of cast iron or structural steel without machining, as the self-alining feature compensates for moderate inaccuracies of mounting. It can also be used as a step bearing for vertical shafts. Three bolts are used on the smaller sizes, and the larger units require four.

The new Shafer take-up units are suitable for conveyor work or any normal-duty applications.

Beaver Model A Pipe Machine

The Borden Company, Warren, Ohio, has recently developed a new model of the Beaver portable pipe machine. This model known as "A," is designed to cut,



The opening head makes it unnecessary to back the dies off finished threads

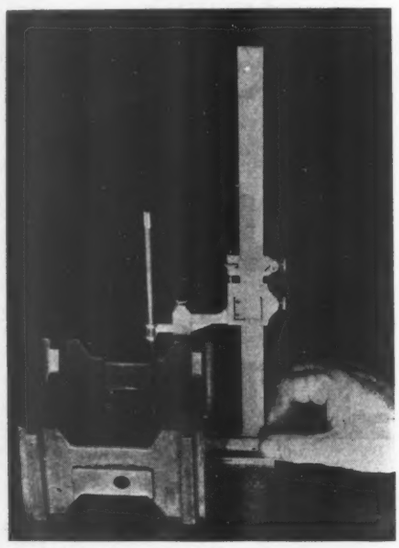
thread and ream steel, wrought-iron, brass or cast-iron piping in sizes from ½ in. to 2 in. Three opening die heads are supplied—½ in. by ¾ in.; 1 in. by 1¼ in.; and 1½ in. by 2 in. The dies are adjustable for oversize, undersize or standard. It is not necessary with this design of machine to back the dies off over finished threads. By means of the lever at the top the head may be opened. The die head may be tilted back out of the way (it is not necessary to take it off) when cutting or threading up to 12-in. pipe using a universal shaft and die stocks and pipe cutters.

This model of Beaver pipe machine has a ½-hp. motor which is reversible at the switch and is connected with flexible coupling. The electrical equipment operates on 110-volt light current. All of the main housings of the machine are made of aluminum which contributes to a great saving in weight. An oil pump on the machine is mounted on the outside where it is readily accessible for repacking and cleaning when needed.

Bolt die heads can be furnished for use in this type of machine.

New Height Gage Attachment

The Brown & Sharpe Manufacturing Company, Providence, R. I., has recently announced new depth gage attachments No. 585A and 585B for use with vernier



The B. & S. depth gage converts the vernier height gage to a depth gage

height gages No. 585 in both the 10-in. and 18-in. heights.

The attachment is easily locked in place on the vernier by means of a clamp screw. The application of the attachment to the vernier height gage quickly converts this tool into a reliable and accurate depth gage. Measurements can be taken accurately over high projections and in deep recesses.

(Turn to next left-hand page)

A mixed train on the Buffalo & Susquehanna near Nelson Run, Pa.

BETTER LOCOMOTIVES

● *SUPER-POWER LOCOMOTIVES ON THE BOSTON AND MAINE*

LIMA LOCOMOTIVE WORKS INCORPORATED

A very great change has come to the steam locomotive.

Locomotive designers now have factors to work with which, as to economy and efficiency, put the locomotive into the class of the best non-condensing power plants of the world.

To the operating official these improvements have brought power units of capacity and efficiency of which his predecessor never dreamed. The operating officer will find in the Super-Power Locomotive the greatest relief to some of his most difficult problems.

Be sure that there are enough of these locomotives available to continue to haul the increased traffic that will come with business improvement.

LIMA LOCOMOTIVE WORKS • Incorporated • LIMA • OHIO

Among the Clubs and Associations

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—The business session of the Fuel Association scheduled for September 15 and 16 at the Hotel Sherman, Chicago, has been cancelled. Programs for this meeting were being distributed when the decision to cancel the meeting was made.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—T. W. Demarest, general superintendent, Pennsylvania, will discuss Car Department Problems at the September 14 meeting of the Car Foremen's Association of Chicago which will be held at 8 p.m., at the Great Northern Hotel, Chicago.

CANADIAN RAILWAY CLUB.—At the meeting of the Canadian Railway Club which will be held on September 14 at 8 p.m. at the Windsor Hotel, Montreal, Mr. Norman, chairman of the Industrial Commission on Unemployment, City of Montreal, will discuss What the City of Montreal Has Done for Unemployment. Moving pictures will describe the work.

AMERICAN SOCIETY FOR TESTING MATERIALS.—The A.S.T.M. Committee B-7, whose chairman is J. B. Johnson, chief material section, Materiel Division, Air Corps, U.S.A., Wright Field, is contemplating the preparation of specifications for aluminum alloys in the form of forgings suitable for engine crankcases, locomotive parts, and miscellaneous forgings. The committee is also arranging to carry on a series of tests to ascertain the best methods of determining the proportional limit for cast and wrought light alloys.

NATIONAL SAFETY COUNCIL.—During the week of October 12 to 16 representatives of transportation companies will meet at the Stevens Hotel, Chicago, to consider practical ways and means to reduce accidents and accident costs. The program of this Twentieth Annual Safety Congress and Exposition will be conducted by the Steam Railroad, Electric Railway, Marine and Aeronautical Sections of the National Safety Council. Standard safety equipment and latest developments in safety appliances will be displayed at the exposition. The Safety Congress will have a total of 130 sessions in 45 different divisions.

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Meeting June 23, 24 and 25, Congress Hotel, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York. Next meeting May 19, 20, 21, Biltmore hotel, Atlanta, Ga.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H. streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—PAUL D. Mallay, chief engineer, transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

MACHINE SHOP PRACTICE DIVISION.—Carlos de Zafra, care of A. S. M. E., 29 West Thirty-ninth street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—L. H. Morrison, associate editor, Power, 475 Tenth avenue, New York.

FUELS DIVISION.—A. D. Black, associate editor, Power, 475 Tenth avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-Fifth street, Chicago. Regular meeting, second Monday in each month except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 608 South Main street, Los Angeles, Cal. Meetings second Monday of each month except July, August and September, in the Pacific Electric Club building, Los Angeles, Cal.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth streets, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Weigman, 720 North Twenty-third street, East St. Louis, Ill. Regular meeting first Tuesday in each month, except July and August, at American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB OF BUFFALO.—T. J. O'Donnell, executive secretary, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 453 East Sixth street, Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler avenue, Cleveland, Ohio. Meeting second Monday each month, except July, August and September, at the Auditorium, Brotherhood of Railroad Trainmen's building, West Ninth and Superior avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—E. A. Jackson, Box 22, Mail Room, Union Station, Indianapolis, Ind. Regular meetings first Monday of each month at Hotel Severin, Indianapolis, at 7 p.m. Noon-day luncheon 12:15 p.m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkless, Room 707, LaSalle Street Station, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3730 South Prieur street, New Orleans, La. Meetings third Thursday.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Car Department Officers Association.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National Montreal, Que. William Penn and Fort Pitt Hotels, Pittsburgh, Pa.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September. Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—Douglas I. McKay, executive secretary, 26 Cortlandt street, New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box, 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

PUEBLO CAR MEN'S ASSOCIATION.—I. F. Wharton, chief clerk, Interchange Bureau, Pueblo, Colo.

RAILWAY BUSINESS ASSOCIATION.—Frank W. Noxon, 1124 Woodward building, Washington, D. C.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, chief clerk, Peoria & Pekin Union Railway, 217 Lydia avenue, Peoria, Ill.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meetings third Tuesday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett. Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—J. A. Murphy, 1405 Canadian National Express building, Toronto 2, Ont. Meetings third Monday of each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eight street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. H. Nash, 343 South Dearborn street, Chicago. Regular meetings, third Monday in each month.

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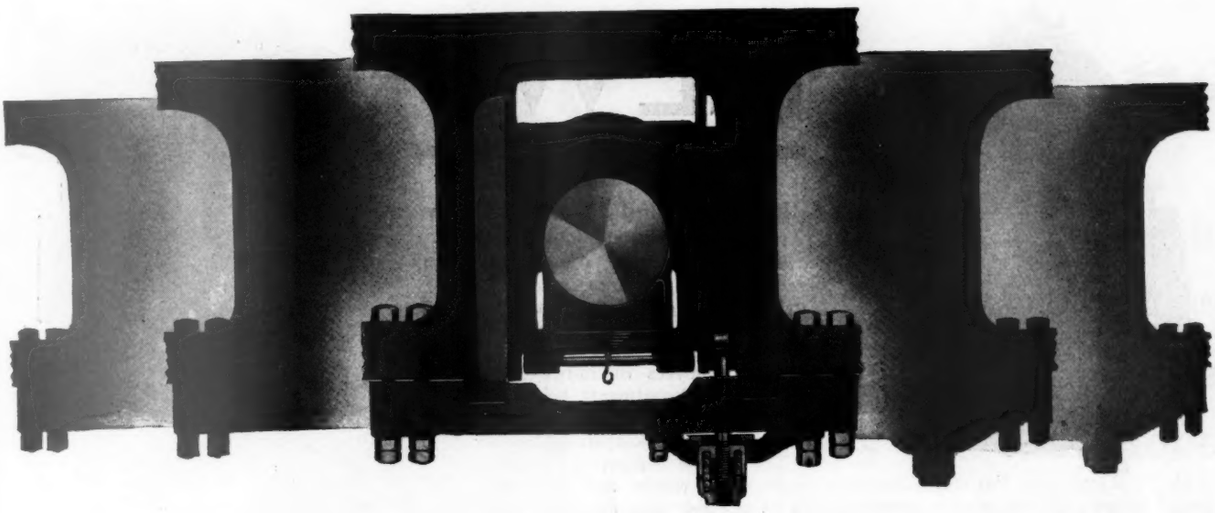


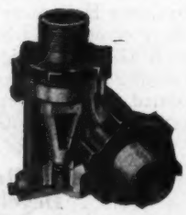
WHY LET SLACK BATTER OUT YOUR BUSHINGS!

SLACK is controllable. You can keep it in hand by making driving box wedge adjustment continuous and automatic.

Close machining of boxes and careful roundhouse adjustment of wedges won't accomplish the desired result because a fraction of an inch must be left to provide for expansion as box temperatures rise.

But Franklin Automatic Adjustable Wedges are set to eliminate any slack, and as driving boxes warm up, the automatic adjustment which takes place constantly provides for expansion without letting slack creep in. It also provides for normal wear.

All over the country, locomotives are running longer between shoppings by reason of the Franklin Automatic Adjustable Wedge.



THE FRANKLIN SLEEVE JOINT

Uses flat gaskets—the cheapest to buy when replacement is necessary

FRANKLIN RAILWAY SUPPLY COMPANY, Inc.

NEW YORK CHICAGO SAN FRANCISCO ST. LOUIS MONTREAL

NEWS

THE ST. LOUIS-SAN FRANCISCO has reduced by 5 per cent the salaries of supervisory officers receiving $250 to $350 a month and of some employees receiving less than $250 who are not on a five-day week. This reduction is in addition to the reduction of from 5 to 20 per cent which was put in effect last January.

THE CHICAGO, ROCK ISLAND & PACIFIC, as a part of its project for the conversion of 231 locomotives from coal burning to oil burning, has undertaken the construction of fuel oil stations at 17 points on its lines south and west of Kansas City, Mo. These stations have a total estimated cost of about $90,000 and all work will be done by railway company forces. Each station will consist of a second hand tank-car body buried in the ground near the fueling track, a track trough for unloading oil into the car body, one or more oil cranes and the necessary pumping facilities. At Armourdale, near Kansas City, a 5,000-bbl. tank for the storage of fuel oil will be constructed.

Railway Men on Relief Committee

R. H. AISHTON, president of the American Railway Association, Daniel Willard, president of the Baltimore & Ohio, and Alvanley Johnston, grand chief engineer of the Brotherhood of Locomotive Engineers, have been appointed by President Hoover as members of the advisory committee which is to assist Walter S. Gifford, president of the American Telephone & Telegraph Company, appointed by the President to organize a system of unemployment relief.

Aluminum Pullman Cars Being Developed

THE PULLMAN COMPANY is experimenting with the application of aluminum to sleeping cars and plans to construct an all-aluminum sleeping car within a year. According to present plans, the entire car, with the exception of the wheels, axles and springs, will be made of aluminum, and, as a result, the weight of the car and the cost of moving will be reduced materially, as compared with present conditions and practice. The interior arrangement of the new car will differ from that of the standard Pullman sleeping car.

Purchases and Stores Division Announces Contest

THE PURCHASES AND STORES DIVISION, A. R. A., has announced a contest similar to contests held in previous years for papers on railway purchases and stores work and problems. The contest is open to all employees of railway purchasing and stores departments below the rank of assistant purchasing agent and assistant general storekeeper.

The article submitted must have at least 1,000 words and not more than 3,000, and the same must be in the hands of the secretary not later than March 1, 1932.

Increased Fuel Efficiency

THE RAILROADS in the first six months of 1931 established a new record for efficiency in the use of fuel by locomotives, according to reports filed with the Interstate Commerce Commission. An average of 122 lb. of fuel was required to haul 1,000 tons of freight and equipment, including locomotive and tender, a distance of one mile. This average was the lowest ever attained for any corresponding period, being a reduction of 3 lb. under the best previous record established in the first half of 1930. In the passenger service an average of 14.8 lb. was required to move each passenger train car one mile, compared with 15 lb. in the first half of the preceding year. Class I railroads in the first half of 1931 used for locomotive fuel 42,672,474 tons of coal and 1,012,932,384 gallons of fuel oil.

Pneumatic-Tired Rail Car Developed in France

A PNEUMATIC-TIRED RAIL MOTOR CAR recently developed in France, performed satisfactorily in a series of tests conducted on the Paris-Orleans and the French State railways, under the auspices of the Michelin Tire Company. The car, according to the description in a recent issue of Modern Transport (London), embodies an adaptation of the automobile design with streamline effects. It is equipped with a 46 h.p. engine and weighs approximately four tons.

The wheel on which the newly-developed pneumatic tire is fitted consists of a central hub with a detachable flanged steel rim, similar to the steel tires on railway rolling stock. The tire rests on the flat rim against the inner flange and is held in position by a smaller flange attached to the face of the wheel. The tire is so designed that a puncture is followed by a barely perceptible deflation and thus the danger of derailment from a blowout is minimized. Among the advantages claimed for the vehicle are its smoother riding qualities and its ability to be stopped in a short distance because of the adhesion qualities of rubber and steel. The vehicle is not now designed for interchangeability between rails and highway.

Railway Labor to Ask Shorter Work Periods

LEGISLATION to provide for a shorter work-day and work-week for railway employees, "to reduce unemployment and stabilize employment," is to be sought by the Railway Labor Executives at the next session of Congress, according to a statement they have just issued in further explanation of the matters discussed at a three-day meeting in Washington in July. An executive committee was directed, with the aid of counsel, to prepare a bill to be introduced for that purpose. The plan has been under consideration at meetings of the railway labor organizations for a long time and the labor executives some time ago tried to

(*Continued on second left-hand page*)

Domestic Orders Reported During August, 1931

Locomotives

Name of Company	Number Ordered	Type	Builder
Lehigh Valley	2	Gas-electric	Electro-Motive Co.
	2	Oil-electric	American Locomotive Co.
	1	Oil-electric	Ingersoll-Rand Co.
Jay Street Connecting Railroad	1	Oil-electric	American Locomotive Co.
Total for month of August	6		

Freight Cars

Name of Company	Number Ordered	Type	Builder
Carnegie Steel Company	30	Hopper	Greenville Steel Car Co.
Litchfield & Madison	4	Caboose	American Car & Fdy. Co.
New York Central	300	Gondola	Company Shops
	200	Gondola	Merchants Despatch Transportation Co.
Total for month of August	534		

Revenue Earners

THE economies effected by the use of strictly modern power will pay for such locomotives well within their life-time — frequently in from 5 to 10 years. Only boiler horse-power and big drivers give Speed *and* Tonnage.

It takes Modern Locomotives to make money these days!

THE BALDWIN LOCOMOTIVE WORKS 1831 1931

THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

ALCO FORGINGS

QUALITY—ALWAYS

A Powerful Forging Press squeezes and works the metal thoroughly to the very center insuring the soundest possible section throughout the forging . . . . . .

ALCO FORGINGS

QUALITY — ALL WAYS

A LOCOMOTIVE is no more dependable than the forgings that go into its construction. The kind of forgings used largely determines the kind of service obtained. On their structural stamina rests the responsibility of keeping the locomotive in revenue-earning service and out of the shop for repairs.

It has been proven unmistakably that getting the greatest ton-miles locomotive output for the fewest maintenance dollars is possible only when forgings embody that extra measure of dependability which makes for long life in hard service.

The extra structural stamina of Alco quality axles, rods, crank pins, drawbars, insures many extra years of trouble-free locomotive performance, necessary for economical transportation and low maintenance expense.

This extra structural stamina is forged into Alco parts by the powerful forging press which squeezes and works the metal thoroughly to the center, insuring the soundest possible section throughout the forging. The powerful squeezing action of this press makes certain that there are no fractures in the forging which will cause trouble in service. The uniformly strong forgings produced by this method will withstand maximum strains year after year without failure. Science proves also that parts forged by the squeezing method have a far greater tensile strength.

The forging press is served by a 5 ton manipulator, which is powerful enough to turn and shift the heavy parts easily insuring not only a thorough working of the metal in the forgings but efficient and economical manufacture.

The profit earning capacity of the modern locomotive is too great to be jeopardized by the use of any other than the best forgings obtainable. Specify Alco—you get quality all ways, always.

American Locomotive Company

30 Church Street New York N.Y.

bring about a conference with the Association of Railway Executives on the subject by including it in a plan for co-operating with the railway executives on methods for dealing with the competition of other forms of transportation. The executive committee includes D. B. Robertson, of the Brotherhood of Locomotive Firemen and Enginemen, A. Johnston, of the Brotherhood of Locomotive Engineers, A. O. Wharton, of the International Association of Machinists, F. H. Fljosdal, of the Brotherhood of Maintenance of Way Employees, and C. M. Sheplar, of the National Marine Engineers' Beneficial Association.

According to the statement the labor executives also discussed at some length, but deferred action on, the subject of unemployment insurance. They also approved certain principles to govern the draft of a bill to provide for "retirement insurance" by which railroads would be required to provide retirement insurance for superannuated employees, to be paid for through voluntary contributions from employer and employee fixed on a sound actuarial basis, "whereby the individual employee will acquire a vested right in trust funds, which can be maintained and enforced by him or his beneficiary just as other forms of insurance." After stating certain requirements the statement said that there has been no plan proposed and no bill drafted which meets these requirements and that no bill will be endorsed by the association until they have been met.

C. N. R. Employees Take Half-Day Off

FOLLOWING an agreement reached between the management of the Canadian National and representatives of the railway employees, it was announced in Montreal that, effective August 1, officers and employees of the Canadian National receiving less than $4,000 per annum would be off duty one-half day per week without pay, and payroll deduction would be made accordingly. This information is contained in an official letter to heads of departments, signed by Sir Henry Thornton, chairman and president of the railway.

The arrangement covers clerical and other forces who are working under union agreements with the company and non-scheduled employees as well. Officers receiving more than $4,000 per year have taken a salary reduction of ten per cent, announcement to that effect having already been made.

So far as practicable, the president's letter states, the half-day period off duty will take place on Saturday morning. Where the Saturday morning is not feasible, employees will be relieved half of another working day.

The arrangement is designed to obviate the necessity of discharging a large number of employees and thereby adding to unemployment. The reductions in the payroll on account of the half-day lay-off per week will amount to eight and one-third per cent.

Supply Trade Notes

THE OHIO BRASS COMPANY, Mansfield, Ohio, has moved its Cleveland office from the Union Trust building, to 540 Terminal Tower.

THE ARMSPEAR MANUFACTURING COMPANY has moved its headquarters from 447 West Fifty-third street to 250 West Fifty-fourth street, New York.

T. R. LANGAN has been appointed northeastern district manager of the Westinghouse Electric & Manufacturing Company, with headquarters at New York City.

L. S. HAMAKER, advertising manager of the Republic Steel Corporation, has been appointed manager of sales promotion, with headquarters at Youngstown, Ohio.

R. E. WALKER, representative of the American Rolling Mill Company, with headquarters at Middetown, Ohio, has been placed in charge of the office at Tulsa, Okla.

THE INGOT IRON RAILWAY PRODUCTS COMPANY, Middletown, Ohio, has opened a branch office at 509 Forsyth building, Atlanta, Ga. E. T. Cross has been placed in charge.

THE READING IRON COMPANY, Reading, Pa., has consolidated its general executive and general sales offices in Philadelphia, Pa., on the tenth floor of the Terminal Commerce building, 401 North Broad street.

THE JOYCE-CRIDLAND COMPANY, Dayton, Ohio, manufacturers of Joyce jacks and Joyce auto lifts, has moved its New York office from 105 West Fortieth street to 143 Liberty street. Arthur S. Beattys, eastern sales manager, is in charge.

JOHN S. BLEECKER, formerly consulting engineer specializing in transportation and merchandising, has been appointed manager of sales of Lukenweld, Inc., division of Lukens Steel Company, Coatesville, Pa.

THE PRESSED STEEL CAR COMPANY, Pittsburgh, Pa., has awarded a contract to the Austin Company for the reconstruction of six buildings, at its Chicago plant, recently destroyed by fire. The cost of repairing the buildings will approximate $60,000.

THE A. M. BYERS COMPANY, Pittsburgh, Pa., has taken a six-months option to purchase the Canonsburg Steel & Iron Works, Canonsburg, Pa. The latter company which is controlled by the Edwards Manufacturing Company, Cincinnati, Ohio, was founded in 1902 and has an annual capacity of 38,000 tons of black sheets and 16,000 tons of galvanized sheets.

WALTER A. DEEMS, for several years in the machine tool department of Manning, Maxwell & Moore, Inc., has opened an office under the name of Walter A. Deems & Co., at 143 Liberty street, New York, as manufacturers agent. He now represents the Edna Brass Manufacturing Company, Cincinnati, Ohio; the L. J. Bordo Company, Inc., Glenside, Pa., and the B. F. Nelson Manufacturing Company, Minneapolis, Minn. Mr. Deems, previous to his service with Manning, Maxwell & Moore, Inc., served as master mechanic on the New York Central and later as master mechanic on several divisions of the Baltimore & Ohio.

HALE HOLDEN, JR., assistant to the president of the Pullman Company, has been elected vice-president of the Pullman Company. Mr. Holden entered the employ of the Pullman Company on September 15, 1922, as a draftsman at the Pullman Car Works, Pullman, Ill., and on January 1, 1923, was transferred to car building and worked in various capacities in both the passenger and freight shops. Later he became an inspector in the mechanical department and then a clerk in the office of the vice-president and general manager. On January 1, 1924, he was placed in the sales department, but returned to the operating department six months later as assistant district superintendent of the central zone, and later in the Chicago Eastern-Southern and Central districts. On February 1, 1925, he returned to sales work with the Pullman Car & Manufacturing Corporation, and five years later became assistant to the president of the Pullman Company.

H. Holden, Jr.

THE ROBERT W. HUNT COMPANY, Chicago, has installed an X-ray laboratory service for the inspection and testing of metallic materials. These facilities are designed to X-ray steel objects up to 3½ in. in thickness and aluminum objects up to 8 in. in thickness, while there is no limit to the size of the specimens that may be tested provided they can be loaded on a freight car.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, New York, has acquired the manufacturing and marketing facilities of Metalweld, Inc., Philadelphia, Pa.,

(Continued on next left-hand page)

10 SERVICES
Contributing to Efficiency in Operation and Maintenance

The name Dearborn has risen to world-wide fame during the last half century, because of the effectiveness of the services here described. Use these services—all of them, and know that the results you desire will be accomplished completely and economically.

Scientific Water Correction

Water supplies are analyzed in the Dearborn Laboratories. Scientifically correct treatment is supplied to overcome scale formation, foaming, pitting and corrosion. In this work, the Dearborn Chemical Company offers the most comprehensive service in the world, backed up by scientific laboratory control, which adjusts treatment as needed to correct variations which may occur in content of impurities.

Dearborn Treating Plants

These inexpensive plants supply Dearborn Treatment to the water with mechanical accuracy. They treat water at half the cost of lime soda systems. Operate automatically on pressure from water main. Occupy but a few feet of floor space.

Cleaning Scaled Equipment

Dearborn Special Formula No. 134 is used widely in removing carbonate scale deposits of any thickness from water lines, cooling jackets, heaters, coils, pumps, evaporators and equipment of all types. Rapid. Thorough. Easy to use. Economical. Eliminates the danger of acid.

Scale Prevention—Heaters—Injectors

Dearborn Formula 103 and an associated series of formulae give excellent results in keeping feed water heaters, boiler feed pumps, injectors, branch pipes and boiler checks free from scale. Introduced in the tender, it reacts with scale forming salts and prevents their deposit.

In 1887 when Theodore Roosevelt had just been defeated in an election for Mayor of New York City and Woodrow Wilson was still an associate professor at Bryn Mawr College, the Dearborn Laboratories pioneered in the chemical analysis of water supplies in overcoming boiler water troubles. In the vanguard of progress, year after year since that time, the Dearborn Laboratories have been engaged in this and additional work with results of constantly increasing effectiveness.

Water Systems

Special treatment is provided to prevent scale formation or corrosion in hot or cold water circulating systems. This applies even to drinking water.

Protecting Laid Up Power

The damage that occurs in laid up locomotive boilers to sheets and flues is caused by condensation in the presence of oxygen. The efficient methods of protection provided by this company are adapted as required to the conditions encountered.

Rust Prevention

NO-OX-ID, the original rust preventive, provides both chemical and mechanical protection. It is in use by over 150 railroads and marine interests, and is also protecting thousands of miles of buried pipe line. Manufacturers and users of all types of steel equipment have adopted it.

NO-OX-ID Fillers

Red—Gray—Black—For use in riveted seams in steel car construction, preventing rust, and presenting a drying surface where exposed to the air, to receive paint.

NO-OX-ID Locomotive Front End Coating

Of high viscosity,—leaves a good protective film under heat conditions.

A Series of Cleaners

Dearborn Cleaners are thorough and economical. Specify No. 4 for cleaning car floors. A cleaner for every service.

+ + + + + + + + + + + +

Every Dearborn Service is as reliable as the one with which you are most familiar. Inquiries are welcomed. Recommendations made without charge.

DEARBORN CHEMICAL COMPANY

310 S. Michigan Avenue, CHICAGO 205 E. 42nd Street, NEW YORK
Canadian Office and Factory: TORONTO

Dearborn
TRADE MARK REGISTERED

builders of portable compressor units. For many years Worthington has been engaged in the compressor industry, and last year took over the manufacture and sale of Gilman rock drills and accessories. Worthington is now in a position to supply the air equipment requirements of railroads and industrial users. The portable compressors will be manufactured at the Harrison, N. J., works of the Worthington Pump & Machinery Corporation, and the engineering, manufacturing and sales personnel of the Metalweld organization also will be located there.

CHARLES P. WHITEHEAD, who has been promoted to the position of manager of sales of the General Steel Castings Corporation, with headquarters at Eddystone, Pa., was graduated from the Culver Military Academy, Culver, Ind., in 1917, and served during the World War in the Naval Reserve Flying Corps, until 1919. After a few months with the Missouri-Kansas-Texas, he entered the employ of the Commonwealth Steel Company on July 1, 1919, and spent several years in the engineering department and also in the different departments of the plant. He joined the Commonwealth Steel Company's sales department in 1922 and since that time has served the railroads located in the western part of the country. On April 1, 1930, Mr. Whitehead was appointed sales assistant to the vice-president and general manager of the Commonwealth division, Granite City, Ill.

Charles P. Whitehead

HARRY R. BARTELL, who has been promoted to the position of manager of the western district sales, of the General Steel Castings Corporation, with headquarters at Granite City, Ill., began his business career in the mechanical engineer's office of the New York Central lines at Cleveland, Ohio, in 1909 and, in 1913, he was transferred to the Collinwood shops' office. He resigned this position in 1915 to accept an appointment as car designer for the Atlas Car & Manufacturing Co., Cleveland, Ohio, and came to the Commonwealth Steel Company in 1916 as chief estimator at the plant in Granite City, Ill. In 1917, he was transferred to the general office as assistant to the chief mechanical engineer, was appointed assistant mechanical engineer in 1920, and mechanical engineer in 1922. Since 1924, he has been a sales engineer, continuing in the same position since the Commonwealth Steel Company was merged with the General Steel Castings Corporation.

Harry R. Bartell

WILLIAM M. SHEEHAN, who has been appointed manager of the eastern district sales, of the General Steel Castings Corporation, with headquarters at Eddystone, Pa., received his academic education at St. Andrews school, Roanoke, Va., and later took university extension work and a special course at St. Louis University. He served an apprenticeship as machinist in the Roanoke shops of the Norfolk & Western and in the drawing room of the mechanical engineer's office. He later held positions in the engineering departments of the General Electric Company, the New York Air Brake Company, and the Keith Car & Manufacturing Co., and, in December, 1913, entered the employ of the Commonwealth Steel Company. He became assistant mechanical engineer on July 1, 1915, and since January 1, 1919, held the position of sales engineer with the Commonwealth and its successor, the General Steel Castings Corporation. On April 1, 1930, he was appointed sales assistant to the vice-president and general manager of the Eastern division at Eddystone, Pa.

William M. Sheehan

R. S. FOLK has resigned as sales representative of the Auxiliary Locomotive Division of the Bethlehem Steel Company at New York to become railroad representative of the York Ice Machinery Corporation at York, Pa. Mr. Folk, who will handle the sale of air-conditioning equipment for passenger-train service, was born in 1887 at Baltimore, Md. He was educated in a private school and in 1906 graduated from the Baltimore Polytechnic Institute. He then worked for two years in the shop of the Baltimore Bridge Company where he completed a course covering all departments in bridge construction. For the next two years he was a draftsman in the engineering department of the Baltimore Bridge Company. He then entered the bridge department of the American Bridge Company at Pittsburgh, Pa., as a designer on bridge and erecting work. Resigning six years later, he was appointed structural sales engineer of the Bethlehem Steel Company at Chicago. He remained in the latter position for three years and for the next two years was sales agent of the General Fireproofing Company at Cleveland, Ohio. He then returned to the Bethlehem Steel Company and for six years was in charge of the structural fabricating department. When the Bethlehem Steel Company took over from the Delaware & Hudson the manufacture and sale of the auxiliary locomotive, Mr. Folk was placed in charge of the sale of this product to all of the eastern railroads. After serving for five years in this capacity, he now becomes railroad representative of the York Ice Machinery Corporation.

R. S. Folk

AN ARRANGEMENT has been made between the Carrier Engineering Corporation, Newark, N. J., the Safety Car Heating & Lighting Company, and the Vapor Car Heating Company, Inc., for the sale and servicing of air-conditioning equipment to the railroads. The Safety Car Heating & Lighting Company will function as the sales distributor of the Carrier air-conditioning and cooling system and will continue to handle lighting and heating equipment. It will also handle the servicing of the air-conditioning and cooling systems. The Vapor Car Heating Company, Inc.,

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